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American and Other Machinery Abroad—III.

[Editorial Correspondence.]

A DIFFERENCE IN CUSTOMS.

If two or more Americans interested in machine production meet, the chances are they will "talk shop." There are those unkind enough to intimate that this is simply because they usually know little or nothing else to talk about; but be this as it may, a very large proportion of American machinists, whether they be proprietors or employés are interested in machinery in other ways than merely as a means of making a living. They quite often manifest an enthusiasm akin to worship of a masterpiece in machine construction. The chances are that this inborn love of mechanism has determined their career in life, and a man who so chooses always remains more or less an enthusiast, and will take genuine pleasure in discussing engineering matters, for much the same reason that an artist likes to talk of art or a musician of music.

There are, of course, such men here also, but I think they are far less common than with us, and the man who builds machinery solely for the same reason that another would keep a grocery store, i. e., to make money, is more frequently met with than in America. This may possibly be explained by the fact that in most cases here establishments are old. Usually, or at least more frequently than is the case with us, an English shop was founded some generations ago by a man who made personal choice of his occupation, and perhaps took pride and interest in it. The chances are that the establishment now belongs to his grandson, whose career in life was in a sense chosen for him and whose education and inherited wealth have caused him to acquire tastes for entirely different things, and may even have led him to rather despise mechanical affairs and have as little to do with them as circumstances will permit. The great value which attaches to a name and to established connections here enables the business to prosper without that enthusiastic interest in it which it was perhaps vitally necessary for its founder to have, and so there is a much larger proportion of establishments here than with us in which the proprietors appear to an American machinery man to be almost painfully lacking in enthusiasm and interest in their business. They give one the impression of being in it simply because their fathers were and of believing that they make good machinery because it is essentially the same as that built by their fathers, and is built by much the same methods. I do not write this as a criticism, but simply as a record of what impresses me as a fact of some importance bearing upon the question of trade relations, and, of course, there are exceptions—shops in which the atmosphere is totally different.

To give an instance: A very well known American tool builder had been in correspondence with an English firm regarding a certain machine tool. The American came over here a short time ago, and, in accordance with the usual requirements here, made an appointment by post to meet one of the proprietors. Promptly at the appointed hour the American was on hand, and upon entering the outer door, found himself in a vacant and rather forbidding-looking apartment, posted in which was a request to "ring the bell." This done, a boy appeared who inquired if the visitor had an appointment. This point ascertained, the visitor's card was taken in, and in a moment the man with whom the correspondence had taken place appeared, bearing in his hand originals and copies of all the correspondence. Without a word of greeting or preliminary remark, he immediately referred to this correspondence and began talking business, and though the weather was quite disagreeably cold, it was only after my friend had, owing to the absense of heat in the room and to his own delicate condition, resulting from a recent attack of grip, declined to be seated and requested to be taken to a warm room, that he was shown into the proprietor's own room, where there was a grate fire. It is difficult to imagine a prominent and honored tool-builder meeting with such a reception in any American shop. Yet it is nothing more than "business" pure and simple—business intercourse stripped of everything else but pure business. I should add, perhaps, that the American had, in the end, no reason to be at all dissatisfied with the interview from a business standpoint.

If, however, one presents letters of introduction from an esteemed friend of the person addressed, thus bringing into the matter an element of personal friendship, then usually nothing is lacking in cordiality and hospitality. You are perhaps asked to have a cup of tea or something stronger maybe, and the resources of the establishment seem to be at your disposal. It is then not solely a matter of pure business.

We are wont to adorn our purely business intercourse with a little more of the amenities of social customs, and I speak of the matter simply as an interesting point of divergent custom. The Englishman who thus conforms to English business usage may be just as well disposed toward a visitor as is the American, who is rather more deferential and a little more courteous.

EXPERT INSTRUCTION.

I have referred to the apparent fact that men throroughly conversant with and competent to show others how to get the best results out of American tools and other machinery used here seem to be needed, and a friend of mine, an American tool builder, had a practical illustration of this a short time since. He makes a hub machine, and has sold a good many of them on this side. Not long ago he met here a man who had purchased one of them, and who expressed himself as highly pleased with it; saying that others who had seen it in operation had been astonished at its efficiency. In the course of conversation it developed that the machine was working at precisely half the rate of production at which it had worked before shipment from the shop in which it was built, and that this was due to the fact that forming and drilling were not being done simultaneously as was intended; maladjustment of tools making this, and the fastest work in other respects as well, impossible. A very few words of instruction served in this case to point out the remedy for the difficulty, and the machine is now working here at the same rate as in America; one result of the experience being that my friend has gone to the cycle-making district, and will endeavor to see all his machines at work, and find out how

they are being handled. There have been no complaints from them, but if any considerable number of them are being worked so much below their normal capacity, as in the instance given above, it might be too easy for other builders to secure competitive orders based upon alleged, and perhaps apparent, superior productive capacity.

It will naturally be a little difficult for Americans who have been raised with automatic machinery and familiar with it all their lives, to realize how easy it is to go astray in the little points that make for efficiency when one has not been thus raised, and whose training has been in other directions. It should not, however, be inferred that there are no shops here where such machinery is used efficiently, but simply that there are many in which it is not so used.

PACKING MACHINERY FOR EXPORT.

A number of those who handle American machinery here have mentioned to me the matter of proper and improper packing of machinery for shipment to this country, and they declare that this is an important matter which should receive more attention than is generally bestowed upon it. One dealer declared that quite fifty per cent. of American machines received in his warehouse were more or less broken; usually in relatively unimportant parts, but sometimes so as to make them useless. He showed me an upright drill, the column of which was broken, and the smaller parts had been mostly taken off to supply the places of similar parts broken on other drills of the same make.

Everyone commends the letter of Chas. Churchill & Co. on this subject published in our issue of February 11th last, and declares that if only machinery were packed in accordance with the directions there given, there would be little, if any, trouble. That letter was based upon something like thirty years' experience in handling American machinery packed in all sorts of ways, good, bad and indifferent, and it is declared that since it has been published there is no good excuse for improper packing.

"REGULAR ENGLISH MAKE."

An Englishman who wishes to say something especially gracious to an American will usually say that he took him for an Englishman, *i. e.*, to be "regular English make," which is usually regarded as all that is necessary to be said about a man or a machine, an axe or a pair of shears. If you go into a "shop" to buy a pair of gloves and are shown a pair that are clumsy, ugly, high priced and ill-fitting, and if you object to them on that account, you are assured that they are "English make, sir," the evident expectation being that you will take this statement as an entirely sufficient answer to all your objections and a guarantee that the gloves must necessarily be the best that the art of man can produce.

A very eminent English engineer touched on this point when I asked him how it was that the American tool builders were making such headway in the English market in competition with home builders. His answer was "Simply because the English tool builders are asleep," and he went on to say that for generations the English had been the leading manufacturing country of the world. It still was so in many lines, but all this time it had been drilled into the Englishman to regard an English product as necessarily the best of its kind —in fact, scarcely subject to criticism. This had come to be, in a sense, an inherited and an ingrained belief, which nothing but time and repeated disastrous lessons would, he feared, correct sufficiently so that things would be seen in their true light. Being a sincere expression of opinion by a thorough Englishman, all of whose interests are centered here, and one who is entirely loyal to English institutions, I feel greater freedom to thus quote him than I should were he less a friend of England or in any way interested in the success of England's competitors.

I said that I thought we had, in our own country, quite sufficient of this form of self-satisfaction. "But not," said he, "among your educated men, whereas here it is found not only among the ignorant, but among educated and otherwise well-informed men."

Indications are not wanting, however, that some headway is being made against this disposition here. In our own line the success of American tool builders is a proof of it, and during a ride through the Strand one day I noticed a large and prominent sign reading, "American Desks," and learned that the American office desk is coming to be very popular here in London at least. Another sign read: "Save half your coal and cure smoky chimneys by using an American stove." It is evidently not necessary to conceal the origin of these articles in order to sell them, but, on the contrary, must be considered an advantage to proclaim it.

DECLINE TO BE RUSHED.

Things in general move much more slowly here than with us. You cannot "hustle" very much, because if you attempt it you find yourself constantly and strongly retarded. One of the American colony over here, when I spoke of this, said, "It is no use for you Americans to come over here and try to rush us Englishmen, because we refuse to be rushed."

An English engineer who is familiar with America said: "We take things a little easier here, and I think we are right in doing so. I regard Philadelphia as by far the pleasantest and most comfortable large city in America, simply because people there take time to live and do not rush through life as though it had but one object, and that to hurry through it as rapidly as possible."

This same engineer, in the course of the same conversation, referred to the influence of English trades unions in retarding English industrial development and related a case which occurred in the Bessemer establishment, where a large order for steel tires for locomotives was being pursued and it was a close contest with Krupp's for the order. Times were dull and it was explained to the men that if they would co-operate and allow certain improved methods and machines to be put in and worked to their full capacity, these tires could be made at such a price that the order could be secured; otherwise it must go to the German establishment. The men declared that their union would not permit the proposed new and more rapid methods; the order was allowed to go to Germany and the men were, for a good part of the time, idle when they would otherwise have been employed. Of course, it seems to me that the men were entirely wrong about this, but at the same time is it not clear that by their action they simply proved themselves Englishmen, "refusing to be rushed"; and is not their refusal "to be rushed" just as much a part of English character as that which made my English friend admire most that American city in which things move at the most deliberate pace? Is not one manifestation the correlative of the other? And if both are the expression of a national characteristic, how can it be expected that one class will readily take on new ideas in this line while the other steadily refuses to do so?

AMERICAN ISOLATION—DISCRIMINATIVE IMPORT DUTIES ON MACHINERY.

We are accustomed to regard our isolated geographical position as an unmixed blessing. It is so politically, no doubt; but at the same time it is plain to be seen that in this matter of international trade England derives a very great advantage from being "at the door of Europe." The world is her market, and the world pays tribute to her. The so-called "balance of trade" is continually and heavily against her, and she grows richer all the time. If times are dull at home her manufactures are shipped elsewhere, and bad times in no one country can entirely paralyze her industries. An American engineer, long a resident here, said our insular commercial position impressed him most strongly during a visit to the United States made a year or two ago. We seemed to him to have our eyes on the ground, and to be unaware of what others in other parts of the world were doing and what splendid opportunities awaited us. As he put it, America is, after all, not much if any farther from the market of Europe than Birmingham is from London, because the freight charges are about the same in each case. He regards the Continent as a more promising field for the future development of American machinery trade than England, and he, as well as others, emphasises the statement that Russia is at present the most promising territory

for future trade in machinery. It is vast, has been held back for generations, and now has as its ruler a young man who has seen much of the world, and thus realizes that Russia has much to gain by development; while the Czarina is hardly less progressive. On this account not only are restrictions being removed, but a stimulus is being given to industrial development, which it is believed promises great things.

England's commercial policy is, as we all know, a broad one, and by reason of it she has certain advantages in some European countries which neither we nor perhaps any other country enjoys. Most of the Continental nations impose an import duty upon machinery, which, of course, is so much of a barrier that our builders must surmount. But in several countries this barrier is not quite so high for British as for our own machinery. I append some figures given me by Mr. W. H. Moore, who is an officer of the Worthington Company and manager of its London house, which has business relations all over Europe.

Import Duties on Machinery per Metric Ton (About 2200 lbs.).

	U. S.	Eng.
Spain	$50	$40
France—if under ¼ ton	60	40
" if over ¼ ton	36	24
Austria-Hungary	42.50	37.50
" " —where brass predominates	75	
Germany	7.50	
" — where brass predominates	20	
Belgium	4	
Switzerland	8	
Russia	65	
" —where brass predominates	200	
Denmark	12	
Italy	24	
Finland	31	

Sweden 10 per cent. on net invoice.

In those cases where no figures are given for English machinery Mr. Moore does not know of a differential rate in favor of England, though there may possibly be such advantage in some cases. At present in most of those countries most important to us, England has no advantage, but in some instances the advantage she now enjoys has an important influence.

It would seem as though, one of the first things for Russia to do if she wishes to take full advantage of what other nations have accomplished in the art of machine construction, would be to abate her present high duty on foreign machinery.

A POINT AS TO RELATIVE PRICES.

I met Hiram Maxim a few days ago and he told me of an incident which has a bearing on the matter of relative cost of American and English machine tools built as nearly as possible alike. He had purchased an American lathe, built by one of our builders who makes a specialty of lathes and builds little else. More lathes were wanted and an English firm of high repute wished to furnish them. Maxim informed them that he would not have the standard English lathe under any circumstances, but finally said, "We want a dozen lathes like that American one; suppose you make us an offer to supply them." This was agreed to and in due time the offer came about as follows: We will make a dozen such lathes for £70 apiece, and we are quite sure the Americans can not beat those figures. When informed that the American lathe had actually been purchased in London for £32 they said "impossible," and when convinced of it gave up all idea of competing.

This, however, is a comparison between an American builder who enjoys the general reputation of giving more for the money in the shape of a lathe than any other of our builders, with one of the highest priced shops here, and such a vast difference does not of course show itself in other comparisons. Mr. Moore, referred to above, informs me, however, that they build their larger pumping engines at somewhat lower cost in Brooklyn than in England, and all their smaller pumps which constitute their regular line of manufacture are made in Brooklyn, for this and the Continental as well as for the home trade.

I do not mean to brag, and as soon as the attack of grip (called here influenza), from which I am at present suffering, will allow me I shall get away from London and see more of shops and what is in them, and feel confident I shall see many good things which it will give me pleasure to commend. But for the present I can do little more than set down impressions received from those who are in various ways interested in and conversant with machinery matters here and I give them for what they may be worth. F. J. M.

London, April 28th.

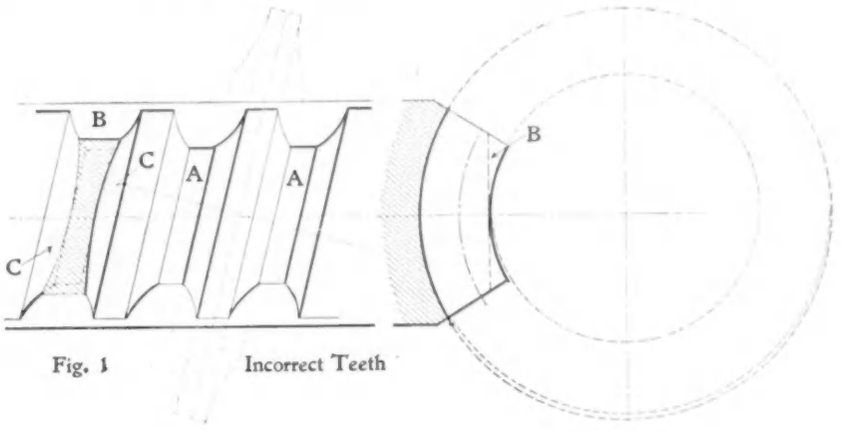


Fig. 1 Incorrect Teeth

Fig. 2

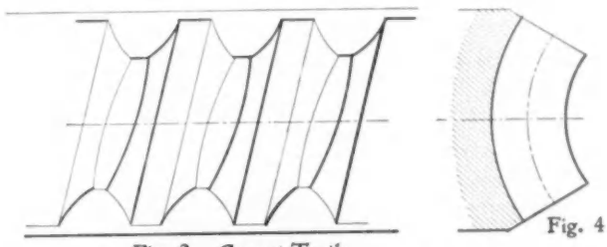


Fig. 3 Correct Teeth

Fig. 4

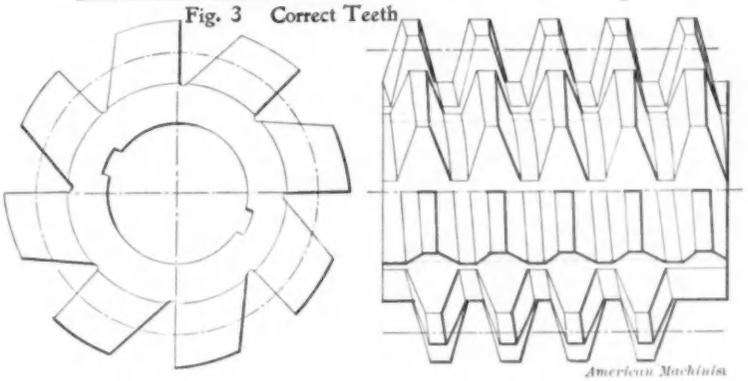


Fig. 5

Fig. 6

CUTTING WORM GEARS.

Cutting Correct Worm Gears with a Single Cutter.*

The worm is a comparatively simple mechanical contrivance, consisting as it does of a few threads of somewhat *V*-shaped section, which can be turned in

*Abstract of a portion of a paper read before the Northeast Coast (British) Institution of Engineers and Shipbuilders by J. H. Gibson.

an ordinary screw-cutting lathe, and which can be drawn by any elementary machine construction student. Not so the wheel, however. The problem of drawing a correct worm-wheel is extremely complicated, and there are few draughtsmen who could do so off-hand without getting tied in a knot.

It is news to many people to be told that the end tips of worm-wheel teeth are thinner than at the middle, especially in coarse pitches, and that the angle of tooth at the tip is greater than at the root. The writer has known quadruple threaded worm-wheels ordered with parallel teeth, and with the inevitable result—days and weeks of chipping to get the twist and thin the ends, so as to gear with the worm.

Some engineers are more wary; perhaps bitter experience has taught them. They turn a worm first and then pare the pattern until it gears. But the expense of patterns and molding is great, and the wheel, when finished, requires much dressing; also the loss by friction in imperfect worm gears is so excessive that their use is often abandoned in favor of a train of spurs and bevels. It may be that this last fact accounts for the fearful and wonderful collection of cogwheels in the tiller rooms of our first-class battleships. They are, perhaps, to be preferred to some of the machine-cut worm-wheels that it has been the writer's sad lot to behold. As a sample, look for a moment at the worm-wheel teeth, illustrated by Figs. 1 and 2. This picture is no nightmare: the wheels are actually fitted in the capstan gears of some of Her Majesty's new battleships not yet in commission. The teeth had unmistakably been cut by a rotary cutter, and naturally the teeth were parallel as shown at *A;* and naturally even a worm would not look at the wheel in that condition, and so the teeth had to be "humored." In the first place the thick ends were very much in the way, so to save thinning them separately they were cut away bodily, as shown by dotted lines at *B;* then by chipping and filing each tooth at *C*, it was found just possible to jam the worm into gear, when no doubt running them together and grinding the worm well in would complete the "job."

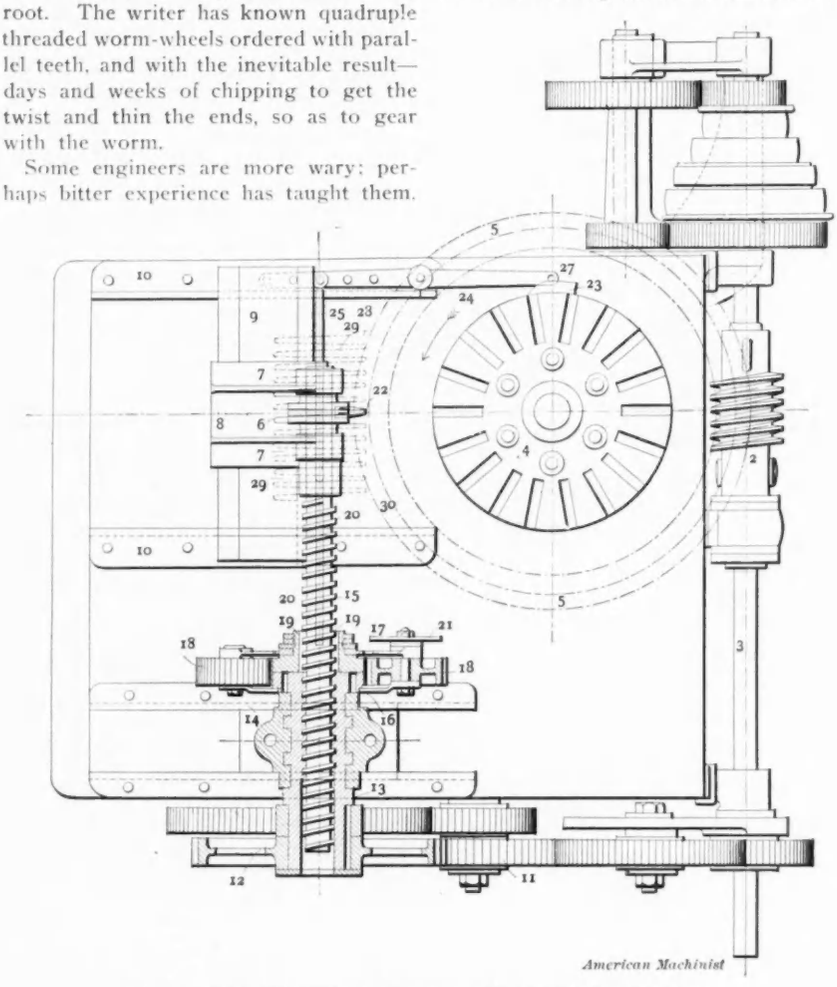


Fig. 7. CUTTING WORM-WHEEL WITH SINGLE CUTTER.

Machine-cut wheels forsooth! Who would like to say when and where the worm gears with the wheel just described? Better say they fit where they touch, and pass on to consider "hobbed" worm-wheels.

Before describing the process of "hobbing," it will be as well to imagine a worm-wheel blank made of butter. The spaces are already roughed out; the finished worm is brought into full gear, and worm and wheel rotated together at their appropriate relative angular velocities. The result would clearly be a perfect worm-wheel, for the worm threads would mold the teeth to the theoretically correct shape. The practice of "hobbing" worm-wheels is based on these same lines. The only difference is that the worm-wheel blank, consisting, as it usually does, of a material somewhat harder and tougher than butter, the worm has to be provided with cutting edges properly cleared and tempered (Figs. 5 and 6); and that the blank is seldom, if ever, rotated by independent means. The hob has to both cut and rotate the wheel, which is usually mounted on a loose turntable for the purpose. The preliminary process before hobbing a wheel is the same as in the case of the capstan wheels just quoted. The good old rotary cutter gaps out the spaces to the same angle as the outside diameter of the worm thread which is to gear with the wheel; then the wheel is placed on the loose turntable, and the revolving hob is gradually brought into gear with it. The hob begins by cutting away the points of the teeth at their ends, and is fed in until it occupies the same relative position to the wheel as will the worm itself eventually. The hob, engaging with the spaces already gapped out, revolves the wheel. This makes a fairly perfect worm-wheel; it would be quite perfect had the hob an infinite number of teeth, were it long enough axially, and could it be arranged that all the teeth were dead true on the helix.

The first condition it is impossible to fulfill because of practical considerations of clearance, etc.; the second condition would double or triple the number of teeth, each one of which has to be carefully backed off on top and sides; and the third condition is difficult of attainment, because, however carefully the hob is grooved and backed off and "got up" generally, you don't know where you are, so to speak, after tempering. It has been well said that a good "hob" is worth its weight in gold; it certainly costs that to purchase from some of the swell machine-tool firms. But there are other objections to the use of the hob in these enlightened days. In the first place it is utterly unscientific; it is as barbarous a proceeding as the cutting of a screw thread on a round bar with stocks and dies, and for exactly the same reason, viz., the difference of angle between the tips and roots. Again, hobs can only be used for cutting wheels having worms exactly similar; and so it happens that, after a turning or reversing gear, a capstan or crane has been carefully calculated and designed—perhaps half made—it is suddenly found there is no hob in stock that will cut the particular wheel required; and then heaven and earth are raised to make a stock hob "work in" and save the expense and time of making a new one. Perhaps the hob that is thus "worked in" is bigger in diameter or of coarser pitch than that required, and so your elaborate calculation goes for nought, and the efficiency of the whole arrangement is impaired.

Evidently, therefore, a simple machine

that will cut perfect worm wheels out of the solid at one operation with an ordinary "fly" cutter, that requires only an outfit of standard screws and nuts of equal pitch to the worms usually fitted, and can, moreover, be put to other uses when not engaged in wheel-cutting, should commend itself to all engaged in high-class heavy engineering work.

Such a machine the writer will now proceed to describe, referring to Figs. 7 and 8. A standard worm wheel 1, operated by a driving worm 2 on the driving shaft 3, is adapted to rotate a face plate 4, to which the wheel to be cut, 5, is secured. A rotatable tool-box 6, carried in bearings 7 secured to a carriage 8, is capable of adjustment to suit the size of wheel to be cut, by moving the slide 9 which can

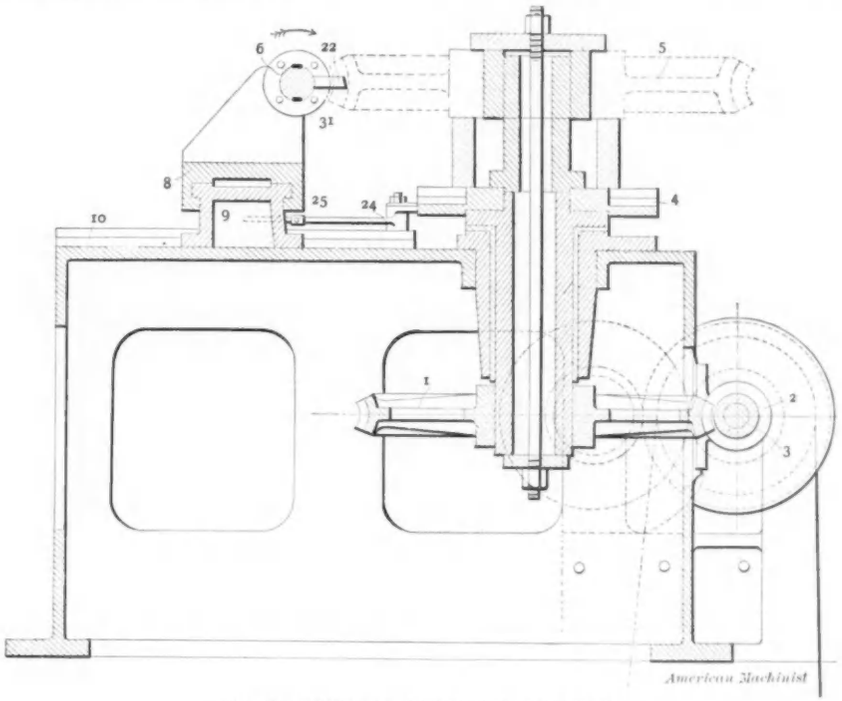


Fig. 8. CENTRAL VERTICAL SECTION.

be clamped down by the side strips. The carriage can also slide freely in the direction of the axis of the cutter shaft. The driving shaft and cutter shaft are geared together by the change wheels 11, which give the required velocity ratio between the turntable and cutter to suit the number of teeth in the wheel to be cut. The last change wheel 12 is not attached directly to the cutter shaft, but to a nut 13, which forms a journal and thrust bearing 14 for the standard screw shaft 15. This nut has a wheel 16 securely keyed to it, having forty teeth, which drives another wheel 17 of equal diameter, but having forty-two teeth, by means of the pinions 18, which engage both differential wheels at opposite sides. The wheel 17 rides on the standard screw shaft 15, but cannot rotate on it because of the feathers 19 which slide in the feather-ways 20.

It will be seen, then, that the rotation of the pinion by the star wheel 21 causes relative movement between the differential wheels 16 and 17, and constrains the standard screw to thread itself through the nut; but while the star wheel remains inoperative, the whole mass revolves together and maintains a rigid connection between the last change wheel and the cutter 22. The star wheel is operated automatically each time the worm-wheel blank makes a complete turn by means of a cam 23, which engages the lever 24 and pushes the rod 25 to the right; the spring 26 brings the rod out of gear when the cam passes the pin 27.

The operation of cutting is as follows: The tool is brought over to the left until it just touches the worm-wheel blank at 28. The machine is then started, and the tool nibbles away until the blank has made one complete revolution, when the star wheel is engaged and the tool is shifted round to another position in the dotted helix 29 by the standard screw being threaded into the nut. The operations then continue automatically until the cutter has worked itself right across the chord and emerges at 30, when the wheel is finished. The tool 22 should then be taken as the template for finishing the worm threads. As the automatic adjustment of the cutter is made once during each revolution of the worm-wheel blank, it will be observed that the action on every tooth is exactly alike, and that the ultimate result is similar to that which would be obtained from a cutting worm or "hob" having an infinite number of cutting edges corresponding to the successive positions of the single cutter. For a double-threaded worm two cutters are used, fixed diametrically opposite each other in the tool box 6; for a triple-threaded worm, three cutters at 120 degrees to each other, and so on. A left-hand screw and nut 15 and 13 must be used in cutting left-handed worm wheels, in which case the tool starting at 30 finishes at 28. In cutting wheels of large diameter, a roller is fitted under the rim at 31 to take the pressure of the cut. The machine can conveniently be converted into a vertical lathe suitable for turning pistons, gun pivot plates, and the like, by substituting one or more ordinary slide rests for the fly cutter, carriage and slide.

The machine has cut about seventy worm wheels, some of which were double-threaded, with most satisfactory results, the wheels being simply perfect, and exhibiting all the peculiar characteristics of accurate worm-gear teeth. Two reversing wheels which were urgently needed for the erection of the first set of engines were sent to Manchester to be cut whilst the machine was being put together. When they arrived and were tried over, it was found that there was 1-16 inch difference in mean diameter between them, and that the centers of worm shafts, instead of being in the plane of the wheel, were considerably out of it. It transpired that to save time the wheels had been cut with a hob of the wrong diameter, thus altering the angle of teeth, and that an attempt had then been made to get the right twist in the teeth by applying a wooden pattern of the finished worm and easing off the corners that fouled with a universal rotary cutter manipulated by hand. There was nothing for it but to "chuck" the wheels in the new worm-gear cutter, and to run a finishing cut through them; the amount of metal that came off some of the teeth was surprising. The wheel-cutting firms may well advise, as they generally do, that worms should not be turned until after receipt of the wheels. This appears to throw the onus of error on the man who cuts the worm, and so the wheel is chipped and humored, generally on the quiet, sooner than have any bother with the wheel cutter, who, of course, is an authority on such matters, and must not be criticized.

As to the cost of machine-cut worm gears, the writer is of the opinion that the general adoption of proper machinery will so cheapen production as soon to render cast wheels a relic of the past. This is already the case with spur gearing; good machine-cut wheels can be had at prices very little more than for wheels with cast teeth, and the time saved in fitting up soon repays the extra cost. Worm-wheel patterns are much more expensive than spur-wheels patterns, as every tooth has to be shaped separately. Add to this the cost of molding and the final cutting, and it will be found that in the long run machine-cut wheels are the cheapest as well as the best. A 30-inch gun-metal worm wheel, 1¼-inch pitch, takes no more than a day to cut out of the solid. Can the cast wheel compete successfully with this?

Machine Grinding—III.

BY C. H. NORTON.

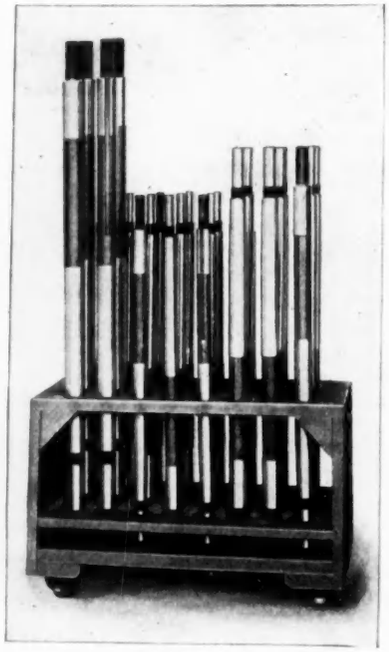
Special water pans, guards and rests, such as shown in Figs. 4, 8, 10 and 11, are inexpensive, and would enable a machine to earn dollars where now it may be standing as a plaything of the tool room.

Fig. 12 shows a rack of ground work.

Fig. 13 shows a spindle ground entire except the thread.

Fig. 14 shows a group of tools from the grinding machine.

The machine shown in Figs. 4 and 5 was fitted up to grind pieces similar to Fig. 15, *A* being the portion ground. It was a slight taper, and the finish size must



RACK OF GROUND WORK.

in all cases be within a limit of one-half thousandth. A roughing cut was taken in the lathe, leaving a variation in size from five to fourteen thousandths over the finish dimensions. The ¾-inch size was 6½ inches long at *A*; of these 450 per day were ground. The 1-inch size was 7½ inches long at *A*; of these 400 per day were ground. The 1 3-16 inches size was 8¼ inches long at *A*; of these 320 per day were ground. The operator ran two machines for this number. If his attention had been given entirely to one machine a little more than half of these numbers would have been produced. I give these figures merely to show that machine grinding is not confined to hardened tool work, but is also an economical manufacturing process.

A word about graduations on the grinding machine may not be out of place here, and it may help to understand the matter better if I state the fact now, that if there were no graduations whatever on it, accurate work could still be produced, if it was provided with an adjusting screw for swivel table, as all first-class machines are.

Graduations are a help to the operator, for they enable him to locate the head stock swivel and swivel table nearly correct at once; but real accuracy must be secured by use of the adjusting screw. It is a common complaint of operators that graduations are wrong, but in every such case known to the writer the fault has been elsewhere. A small error in position of head-stock swivel will carry the zero mark on the table off many times more. It is also very rare that centers are exactly true. We must keep in mind that the grinding machine is one of the most sensitive indicators of error we have. As before stated, an error of one one hundred thousandth is easily detected in most cases. Any error of the setting is doubled on the work, so that, even though a magnifying glass is used it is very rare that the two lines can be set to exactly coincide. An error of one-twentieth of a thousandth in the setting of the head stock zero will give an error of work one-tenth of one thousandth; and more, as the center point is usually on a larger radius than the graduations. This

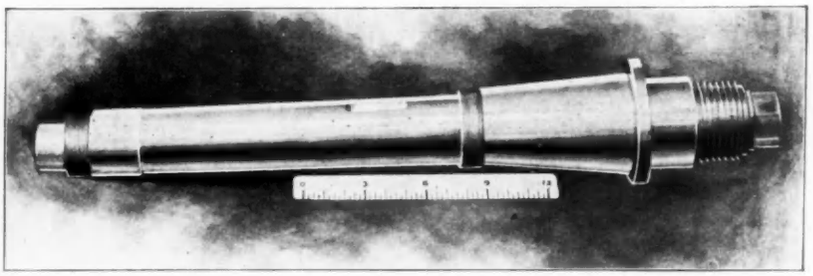


Fig. 13. SAMPLE OF GRINDING.

would spoil most work. Now let the center point be out one-twentieth of a thousandth in same direction and something over two-tenths of a thousandth is the error of work; then when we make the same error in setting the swivel table we have more still and perhaps the foot center is out also.

All of these errors are so small that no one of them can be detected without a fine indicator. So when we talk about errors of graduations we should be very sure of our ground. When we realize these facts we can see how absurd is the suggestion to use a pin, or stop for table or head stock swivel, with the thought of obtaining accuracy. But we have the adjusting screw which is the meat of the grinding machine. It makes it possible to ignore all fussy refinement as to setting to graduations, and we get exact work regardless of these errors.

The speed of work and cut of wheel, bear such close relations that we must consider them together. A good machine is provided with a large range of speeds for work; for if a piece 1 inch circumference is grinding successfully with a given wheel, and the wheel is sizing accurately in response to the graduations on the cross-feed wheel, a piece 2 or 3 inches circumference would (with the same wheel and number of revolutions) show a coarser surface and the wheel would cut larger than the showing on cross feed; at the same surface speed the results would be the same.

The revolution of the work can be compared to the table feed of the milling machine. With a cutter running at a suitable speed to cut steel, there is a feed at which the cutter will do its work easily. There is also one so fast as to break the teeth, supposing we have the necessary power in the machine. There would also be much more heat generated with the fast feed. If we run the cutter after it has lost its keen edge it will generate more and more heat until at last it will become so dull that heat enough to draw the temper will stop further work. It is also true that a cutter whose temper is hard enough for one job, might entirely fail on another. So a wheel that will cut soft steel well, will become glazed if cutting hardened steel and cast iron; and if we continue to use the particles after they are dull they will heat more and more, and on account of the pressure required, will not grind round or straight work. A wheel for machine grinding must cut without pressure; therefore, it must always be sharp; this is accomplished by the breaking out of the particles; but if we have a wheel that is of the right grade to cut at a given work speed and still hold its sizing power, we shall tear away the particles too fast if we revolve the work faster; then the wheel will loose its sizing power. From this we can see that the work speed should always bear the proper relation to the cut of the wheel regardless of the work diameter; just as the amount of feed in milling bears relation to the cutter and material, regardless of the length of the piece being milled. With very slim work, rapid revolutions will probably make it resist bending better, in which case a harder wheel should be used.

In machine grinding it is desirable to break away the particles as they become dull by the act of grinding, in order that the cut may be consant; giving the least possible pressure and heat. It is this faculty of yielding to, or resisting breaking out of the particles, that we call the grade. The one from which the particles can be broken the easier is called soft; the one that retains its particles longer is called hard. It is evident that the longer the particles are retained, the more dulled

they will become and the more pressure will be required to make the cut. It is retaining the particles too long that causes what is familiarly known as "glazing."

Wheels are made in a number of grades in order to meet a great variety of conditions without the necessity of changing the wheel speed for every condition. Wheels for soft steel are harder than for hardened steel and cast iron. For brass, copper and rubber they are much softer. The temper of a wheel is dependent upon the quality of the corrundum particles to withstand dulling, so that the better the material the better the temper.

The question of table speed enters into economical grinding also. One way to do more work is to increase the number of revolutions of work, keeping same relative table feed, but this imposes more work upon each particle of emery and may be disastrous to plans for sizing by the use of graduations on the cross feed wheel. Another way is to increase the width of wheel.

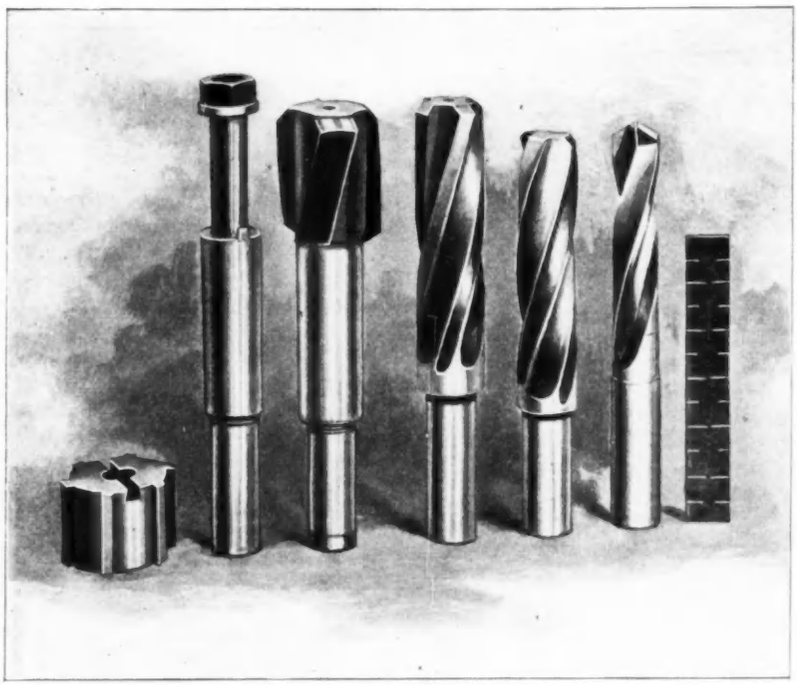


Fig. 14. GROUP OF TOOLS GROUND.

There is a notion among grinding machine operators, that all wheels, on all work, are better with a portion of their face turned away, leaving in some instances, little more than a knife edge. Back in the days of dry grinding this was necessary, for it was impossible to take a wider cut on account of the heat; the operator then did not, and many now do not, appear to understand that heat is the cause of what they call "the chatter of a wide wheel." It is true, however, in many cases, that the operator is forced to cut away the greater portion of the wheel face because the management see fit to furnish wheels unsuited to the work; that is, so hard a grade, or made of such a combination of materials that they will not cut freely.

Those interested in the expenditures of a plant perhaps would like to know that every reduction in the cutting face of the wheel increases the time required to do the work, that is, a wheel ⅛ inch wide, cannot be fed more than 1-32 inch; while one ½ inch wide can be fed ⅛ inch or more, and a ¾-inch wheel ¼ inch or more per revolution of the work. With a wheel too hard for the work in hand these feeds must be much less, as the hard wheel will leave feed marks if not fed slowly. A much greater feed can be taken if the work is such as will admit of a soft wheel being used. The other reason for more emery in contact is that a deeper cut can be taken; in fact the faster feed and deeper cut can often be combined.

It may be interesting to know that, with No. 80 emery and a wheel ¾ inch thick and 12 inches diameter, there are 180,000 or more cutting points at work every revolution of the wheel, and 396,000,000 per minute. Now reduce the wheel to ⅛ inch face and we have only 30,000 per revolution, 66,000,000 per minute as against 396,000,000 of the ¾-inch wheel.

An illustration from experience may be interesting here. Two machines stood side by side; one an old timer, the other a modern machine. There was complaint of the new machine, and the statement was made that the old one would do the best work. The operator was asked to stand by while a certain piece of steel was ground in the new machine, using a ½-inch full face wheel with plenty of water. This piece was one easily thrown out of truth by heat. Eight thousandths were taken from the diameter in five minutes, and no chatter or grinding-on-one-side occurred. The operator then took it to the old dry machine in which was a wheel with a narrow face about ⅛ inch. Great difficulty was experienced with the wheel cutting on one side and when five minutes had elapsed he had cut off but one and one-half thousandths.

Wide wheels and fast table feeds can be used on all work where the wheel can pass one-quarter to one-half of its thickness past the end of the work or over a recess. But a narrower wheel is best when grinding against shoulders not recessed, or when recess is narrow. One-half inch seems to be the widest that can be used for the latter purpose, thus it is that the makers furnish this wheel with their machines. But a wheel three-quarters of an inch thick can be used on the modern medium size machine. The wheels used on the machines shown in Fig. 4 and Fig. 5 were ¾ inch thick, 12 inches diameter. No. 80, grade M; also No. 80, grade N—these for soft tool steel.

There is a "chatter" that may be found with a wide wheel if the spindle and machine are not heavy enough for the cut, but it is of a very different nature from the chatter usually complained of, and is

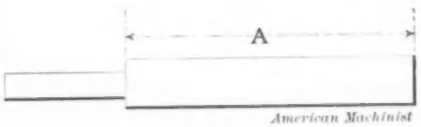


Fig. 15

easily detected. A first-class machine, however, will have a spindle of sufficient strength to carry a wheel as wide as space is provided for.

There are wheels that will chatter under cut with most any spindle. But as they are worthless for other reasons they need not be considered. The selection of wheels is really a very simple matter when once understood, but they cannot be purchased of every wheel dealer. It is not necessarily true that a dealer knows anything about wheels for machine grinding, simply because he represents the maker of them. If you have a grinding machine you can use any wheel your fancy dictates, but you will be the loser if you do not furnish suitable wheels for the work in hand. No one wheel is suitable for all jobs, although it might do them all, after a fashion. Economy of time and accuracy require that we use a variety of grades and a number of wheels.

Thanks are due the Brown & Sharpe Manufacturing Company for photographs and the freedom of their works in preparing these articles.

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Mr. H. M. Norris has just severed his connection with the Garvin Machine Company, of this city, and accepted the position of superintendent and mechanical engineer with the Bickford Drill & Tool Company, Cincinnati, O.

Rapid Methods in Instrumental Drawing.*

Engineering drafting is largely mechanical work, and the instruments or tools which are used are, therefore, of primary importance. For their quality and accuracy the draftsman must depend largely upon the reputation of the firm who makes them, but for improvements in their design his own appreciation of the value of labor-saving machinery should lead him to invent or adopt new devices that will enable him to do his work with equal or greater accuracy and in less time than by former methods. Unfortunately, however, draftsmen as a class are very conservative workmen, and are slow to see the need or advantages of new and improved instruments or methods.

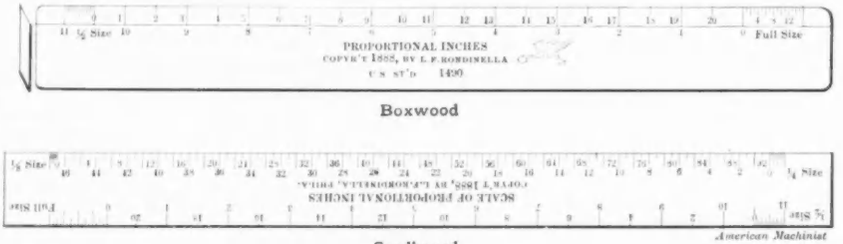

Fig. 1.—Scale of Proportional Inches.

The inconvenience which his students found in using the architect's scale for half-size measurements led the writer to search for a proportional scale having the inch for a unit, and, not finding a practical one, he devised the scale of proportional inches shown in Fig. 1. This is arranged exactly like the architect's scale (of proportional feet), but its purpose is entirely different. Its units represent inches, and the one beyond the zero point is, therefore, subdivided into sixteenths instead of twelfths for fractions of an inch. The method of using it for plotting inches and fractions will be self-evident to all who are familiar with the architect's scale for plotting feet and inches, and on drawings where all sizes are expressed in inches it will be found a great time-saver.

For convenience in construction, mechanical engineers and architects base polygonal forms on the equilateral triangle, the rectangle, the regular hexagon, and the regular octagon, and their draftsmen have usually plotted angles from right-angled triangles accurately made of sheet material, with the acute angles 45° x 45°, 30° x 60° and 22½° x 67½°. Those who have only the first two of these triangles can plot, with the aid of the T-square, all angles that are multiples of 15 degrees, while those who have the third also, can plot all multiples of 7½ degrees. As it requires very careful manipulation in combining two triangles against the T-square to form such angles as 15 degrees or 37½ degrees, and as it is inconvenient to have many instruments on the drawing board or to change frequently from one to another, some few attempts have been made to devise a single instrument to take the place of the first two or of all three of the triangles above named, but the results have generally been too clumsy or expensive to be practical. The writer has spent considerable thought on this problem and has invented several forms, of which the best two have been in public use for some time, under the names of the "Double Triangle" and the "Tetrangle." These are both quadrilaterals of hard rubber or of transparent celluloid, having one or more inside edges made accurately so as to be used in addition to the four outside edges.

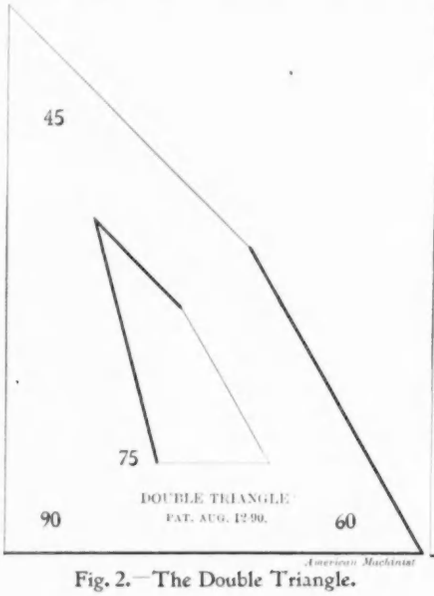

Fig. 2.—The Double Triangle.

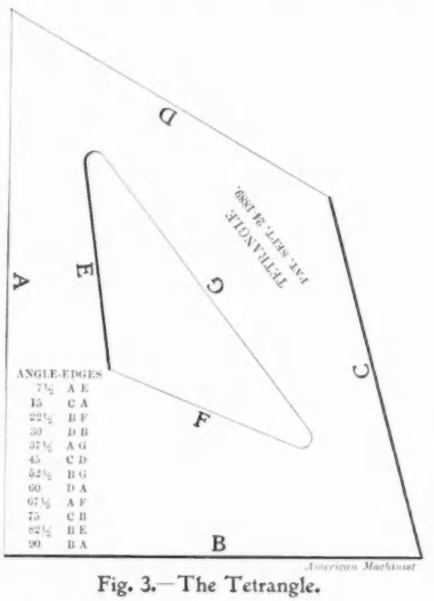

Fig. 3.—The Tetrangle.

The double triangle, illustrated in Fig. 2, is for plotting multiples of 15 degrees. Two of its outside edges are at right angles to each other, and form the angles of 30 degrees, 45 degrees, and 60 degrees with the two other outside edges, and the angles of 15 degrees and 75 degrees with the longest inside edge.

The tetrangle, shown in Fig. 3, is for plotting all angles that are multiplies of 7½ degrees. The sides of this right angle form the angles of 15 degrees, 30 degrees, 60 degrees and 75 degrees with the two remaining outside edges, and with one of the latter against the T-square blade the other makes the angle of 45 degrees with it. The angles of 7½ degrees, 22½ degrees, 37½ degrees, 52½ degrees, 67½ degrees and 82½ degrees are formed by the three inside edges, as shown in the table of angles that is stamped on each instrument.

Fig. 4.

For use in radial measurements a cardboard scale should be selected, with the desired proportional graduations on a perfectly straight edge, and it may be prepared as follows: A knife cut should be made from the blank edge about two-thirds across the scale at about one-quarter of an inch further in than the zero point, and the face of the cardboard should be scored from this cut to the end of the scale, forming a flap to be turned under and pasted to the back of the cardboard. When thus arranged, as shown in Fig. 4, a fine prick-point or needle can be pushed through the projecting part exactly at the zero of the scale, and may be driven through the drawing paper into the board, at any center point.

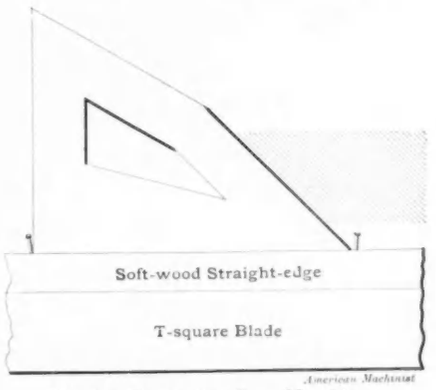

Fig. 5.—Device for Cross-Hatching.

To make the cross-hatching on large section surfaces regular, without the aid of some spacing device, requires consider-

* Abstract of a paper read before the Engineers' Club of Philadelphia by Prof. L. F. Rondinella.

able time and experience, with strain upon the eyes; and though there are several excellent section-liners on the market, they are so expensive that but few draftsmen use them. A very good device, and one that has long been used in some drafting rooms, can be made out of a soft-wood straight-edge, about one-eighth inch thick (e. g., a penny ruler) and two pins, to be used with a triangle and against a T-square blade. One side of the triangle is placed against the upper edge of the soft wood on the paper, so that an adjacent side forms the angle desired for the hatchings, and the pins are driven into the edge so that the corners of the triangle can strike against them, the distance between the pins being equal to the side of the triangle plus the desired distance between the hatchings. To use this device, the lower edge of the soft wood is placed against the upper edge of the T-square blade, as shown in Fig. 5. With the triangle against the left-hand pin, a line is drawn along its right-hand edge; the triangle is still held firm, and the straight-edge is slid to the left until stopped by the right-hand pin; the straight-edge is then held firm, and the triangle slid up to the left-hand pin; a second line is then drawn, and this process is repeated until the section surface is covered with equidistant lines. After a little practice, work can be done very rapidly with this device, and the eyes are not strained to judge the distance between the lines.

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A Universal Line-Spacing Instrument.

The device herewith illustrated is well deserving of the attention not only of all draftsmen, but of mechanics and engineers generally. We have purposely

Fig. 3

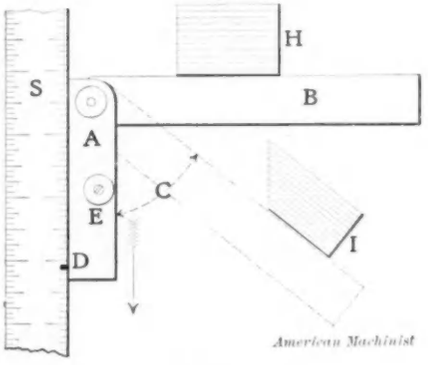


Fig. 1

A UNIVERSAL SPACER.

avoided calling the arrangement a section liner, because we all know that the devising of section liners has been rather overdone, and any new comer in the same line is likely to attract little notice or appreciation. This is a simple and handy section liner, but is much more than that. It accomplishes, as readily as common section lining, the exact subdivision of any given space into any number of equal parts by means of parallel lines. It is entirely independent of the scale of the drawing, working to one scale as well as to another.

The instrument consists, as will be seen by Fig. 1, of a steel straight-edge or rule S and the bevel $A\,B$. The rule is 18 inches long by 1 inch wide and a little over 1-16 inch thick. It is graduated on

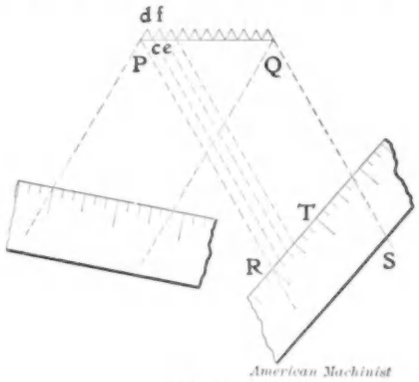
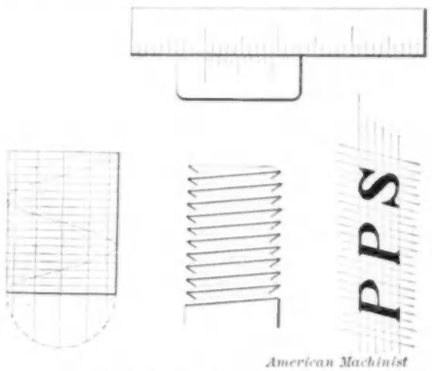


Fig. 2

A SPACING JOB.

the four corners 14, 16, 20 and 24 to the inch, respectively, for the entire length. The bevel is quite light, the beam A being of wood and the blade B of thin steel. E is a handle, and at D is a little detent of very hard steel which drops into the nicks on the scale. The detent is made with a steep angle on one side and an easy angle on the other, so that it moves quite easily in the direction of the arrow and still drops with precision into each mark as it is reached.

In use, the rule is laid upon the drawing and held by a paper weight at each end. The stock A is slid along the edge of the rule with the left hand by the knob E, and as the detent D drops into the graduations, the lines are successively drawn.



SAMPLES OF SPACING.

The stock A is not lifted at all, but simply slid along. If the blade B is at right angles with the stock A, the spaces at H are equal to the scale divisions; if the blade is inclined, the spaces (as at I) are less than the scale divisions in the ratio sine C : 1. To divide a given space (as $P\,2$, Fig. 2) into any number of equal parts, as 11, draw $P\,R$, $Q\,S$ parallel to any direction required for the lines to be drawn. Set the rule, as at T, so that 11 divisions, or some multiple of 11, are included between $P\,R$ and $Q\,S$. Set the stock against the rule and the blade parallel to $P\,R$. With the detent in the nearest mark, move the rule endwise, and the stock A with it, so that the edge of the blade comes to $P\,R$. Then draw the required lines, as $c\,d$, $e\,f$, etc.

Fig. 3 is merely a suggestion of the kinds of work to which the instrument is adapted. It is called the "P. P. (proportional parts) Section Liner," and is the invention of Prof. Albert Kingsbury, Durham, N. H.

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A Traveling International Exhibition.

There is now in process of organization a United States Trades Exposition, which is an undertaking for making a thorough exhibition of American products and manufactures to the people of Mexico. It is to consist of a long and complete vestibuled railroad train, loaded with typical and up-to-date American goods, arranged in attractive and instructive form, the train to make a six months' tour of our neighbor republic, stopping at twenty-seven of its principal cities, and giving everywhere free exhibitions. The stops will vary in duration, from two or three days in the smaller towns to three weeks in the city of Mexico. Space in the cars will be let to exhibitors as in other expositions, and every facility will be provided for the secure transportation and most efficient display of goods exhibited. The exhibits may or may not be accompanied by men to explain and look after them. Advertising space outside the cars will be allowed in proportion to the space occupied within. The train is scheduled to leave Jersey City on August 3d, and will run throughout as a special, doing as much as possible of night travel. The distance traveled will be over 10,000 miles. The undertaking has the indorsement of President Diaz, of Mexico; Hon. John Sherman, U. S. Secretary of State; Hon. Lyman Gage, Secretary of the Treasury; Senior Matias Romero, Ambassador and Minister Plenipotentiary from Mexico to the United States; also the sanction and approval of the National Association of Manufacturers of the United States, who are directly interested and will participate in this movement to increase our export trade with out sister republic. The business manager of the enterprise is J. D. Prince, Temple Court, New York city.

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The "Holland" submarine torpedo boat was successfully launched on the 18th inst., and will soon be ready for trial. Her advent may mark a new era in naval warfare, and, though comparatively a very small craft, she may prove a terror to the largest vessels afloat.

Repairs of Electrical Machinery—Commutators.

BY A. R. HARRIS.

Commutators are generally regarded as the most delicate part of electric machines, and as a matter of fact they are, but the degree of delicacy they may possess is dependent upon the accuracy of the proportions between the armature and the field magnetizing forces. If the field is relatively strong, the point of commutation—i. e., the point where the brushes should be placed to give the least spark—will be changed but slightly by

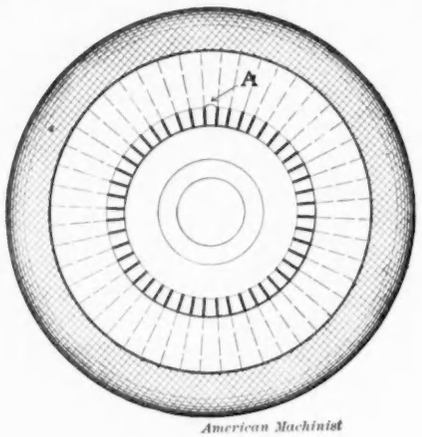

Fig. 1

variations in the strength of the current, and as a consequence, the sparking can be kept down to a nearly imperceptible amount; but if the field is weak the variations in the current strength will cause the reaction of the armature to vary within wide limits, and consequently it will be impossible to so adjust the brushes that they will run well at all loads. When the armature greatly overpowers the field, the sparking may become so serious as to be able to destroy the commutator in short order, and especially if in addition

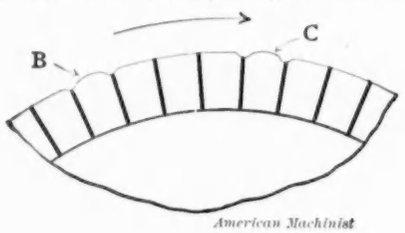

Fig. 2

to this strong armature reaction, the commutator is made with such a small number of segments that the difference of potential between them can rise sufficiently high to sustain a spark of considerable length. Under such conditions it is not uncommon for the spark to pass from one brush to the other, and cause the machine to "buck," as it is called. If this action continues for any length of time, and the current passing is very strong, the result is likely to be that the heat developed by the spark, which will amount to an actual blaze all the way around the commutator, will completely destroy the insulation between the segments, and render the structure useless. When such a mishap occurs there is generally no remedy other than the replacement of the commutator; but as this does not remove the cause of the trouble, the same difficulty is almost sure to be repeated. The best way out of such a scrape is to get a new machine more properly proportioned; if this cannot be done, the next best thing is to endeavor to equalize the load in some way so that the brushes may be set at the point where they will run with the least spark at that load; then, there being little or no variation in the current, there will be no tendency for the spark to increase. Fortunately, machines of this kind are not turned out by any of the best makers of the present day.

Loose connections between the armature wires and the commutator segments are not very uncommon, but they are easily detected, and as easily repaired. In the majority of cases the armature wires are attached to the commutator segments by soldering, but many manufacturers prefer to use screw clamps. With the former style of fastening, a connection cannot become loose, but the wire can break off, which amounts to the same thing. If the machine is a generator, the effect of the loose or broken connection will be to stop the generation of current; but if a wire is held on one of the brushes and the end is pressed upon the commutator, some distance in advance of the brush with which it is connected, the current will again start up. By this experiment it can always be ascertained whether the suspension of the current is due to broken connection with the commutator or not. In the case of a motor, the effect of the broken connection is to cause a long spark of a spitting nature, that can be seen to pulsate in unison with the revolutions of the armature. If upon investigation it is found that the wire has broken off, the end can be spliced out to the proper length and then be secured in its proper place, in precisely the same manner as previous to the break—that is, either soldered in place or clamped.

With the commutator proper, the principal cause of trouble is the developing of an uneven surface. This may be due to a soft spot in some portion of the surface, or to a loose segment. If the unevenness is due to lack of uniformity in the density of the material, the only remedy is to true up the commutator by turning or grinding. There are attachments made for truing up commutators in place, but they can only be used with generators, and when used, the brushes must be removed, so as to avoid all possibility of having a closed circuit, and thus generating a current while the truing-up process is going on. A motor commutator cannot be trued up in place, unless the machine is located where it can be driven during the operation, as the work cannot be done while the current is on.

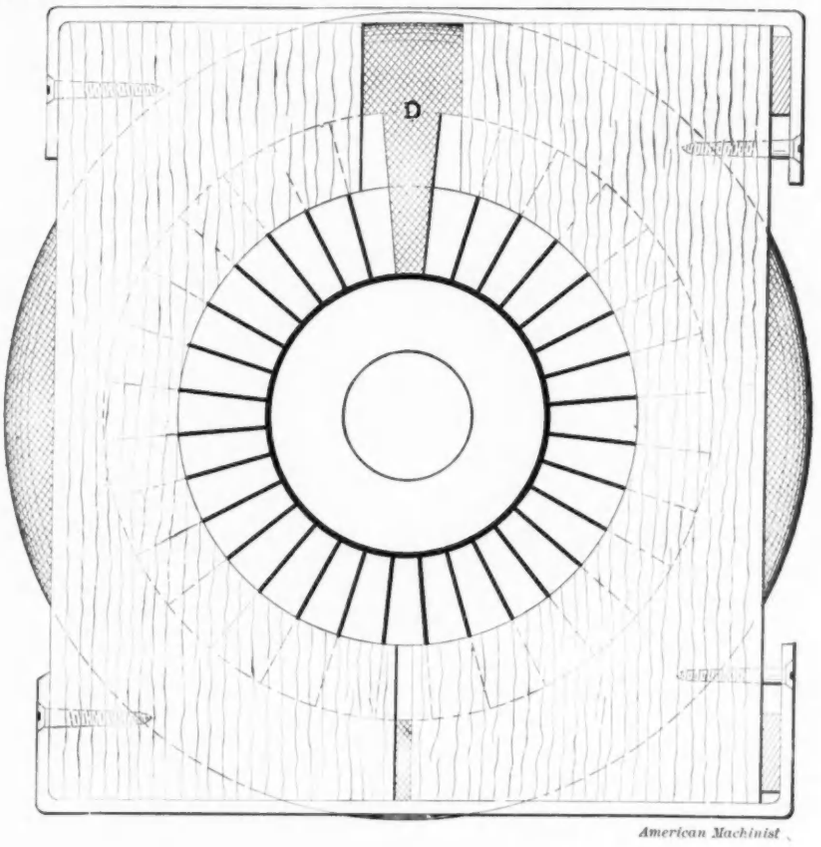

Fig. 3

The unevenness above referred to comes

about gradually, and never reaches a dangerous point, except through the carelessness or ignorance of those in charge, but the unevenness due to a loose segment is apt to develop in very short order, and can become decidedly serious before its presence is noticed, although generally it does not develop so fast.

In small commutators the only way in which a segment can become loose is by moving out from the center, as shown in Fig. 1. This is the only direction in which movement can take place, because the segments are so decidedly wedge-shape that they cannot drop in toward the center without becoming tighter. This can be clearly seen by looking at the vacant space *D*, in Fig. 3. In large commutators, the segments are nearly parallel, and therefore can move in, as well as out, if they are not properly secured in both directions. The segments of small

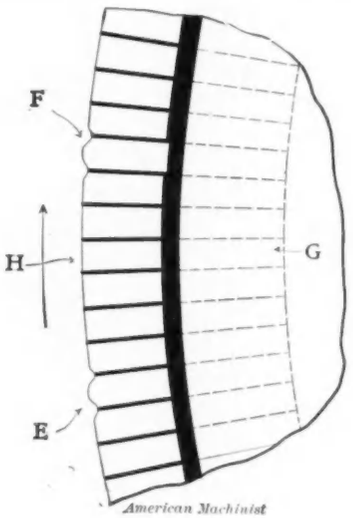

Fig. 4

commutators are made of the shape shown in Fig. 5, or some modification involving the same general principles. They are held in place by the pressure on the end bevels *N M*, and as this pressure draws the segments toward the center, it also presses them tightly together, but not necessarily tight against the bottom. Even if the pressure with which the segments bear against each other is not very great, they will have very little chance to move inward, because a very small movement in that direction will tighten them. With large commutators this is not the case, for as the segments are nearly parallel, it would require a considerable inward movement to take up a very small slack. On this account, large commutators are made so as to hold the segments from moving in as well as from moving out. This is accomplished by having two bevel surfaces at the ends, instead of one, as shown in Fig. 5.

If a small commutator revolves very fast, the loose segment will fly out of place as far as the looseness will permit it, and will stay there. It will not move the whole distance at once, but gradually. As soon as it rises above the surface, the brushes will strike against it and tend to loosen it still more; this will enable it to move out further, and the process will continue until the bevel ends *N M* come to a solid bearing against the end insulation and prevent further movement. If the velocity of the commutator is not very great, the segment will be depressed as it passes under the brushes, providing the tension on the latter is sufficient. If the direction of rotation is as indicated by the arrow, the effect in both cases—that is, when the segment flies out and stays there, and when it moves back every time it passes under the brushes—is shown at *B* and *C*, Fig. 2. At *B* it will be noticed that the segment is above the surface of the commutator, the front side is beveled off from the wearing action of the brushes. The segments in front and back of it are worn away at the corners, on account of the sparking which takes place when the brushes hit the high segment and bounce off the surface. The segment back of the

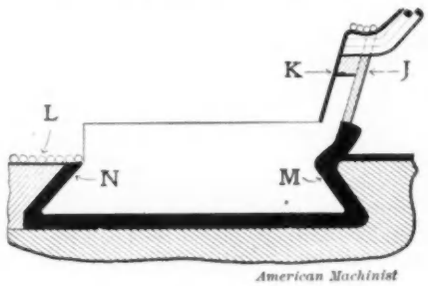

Fig. 5

high one is worn away the most. At *C* the loose segment is shown on a level with the others, and the one in front of it is seen to be worn much more than in the previous case, owing to the fact that when the brush strikes the loose segment, it not only wears off its corner, but also depresses it, and the brush, in following it up, wears away the corner of the forward segment.

Fig. 4 shows the appearance of a large commutator with a loose segment *E*, showing the position when not under the brush, and *F* when under it. From both Figs. 2 and 4 it will be seen that whether the segment is depressed or not by the passing brush, it is always above the surface at other times, and therefore when hit by the brush, causes the latter to jump off the surface and spark, thereby increasing the defect.

To repair a defect of this kind, it is necessary to properly secure the segment, and also to even up the surface of the commutator at that point. If the segment has been badly worn it may be necessary to replace it with a new one, and this may have to be done with the two adjoining ones. Duplicate segments can be obtained from the manufacturers of the machine.

If the commutator is small, the safest course of procedure is to make a wooden clamp, as shown in Fig. 3, that will cover nearly all the surface. This can be held in place in a great many different ways, depending upon the facilities at hand. Usually the segments are stuck together so well by the insulating varnish used in the process of construction that there is very little danger of the commutator coming apart when the end ring is taken off, even if the clamp is not used; but as a clamp is easily made, it is best to use it. When the new segment or segments are fitted in place at *D*, they should be large enough, in every direction, to project beyond the others so that it may require some pressure to force them into place. The bevel *N*, which will be the only one visible, should project beyond the other segments, and the top should stand some distance above the others. It is better to have the segment too tight than too loose, and if when the end clamping ring is put on, it is found that it cannot be forced up so tight as to bring the segments down to the proper place, it can be removed and the segment made shorter and the insulation on its sides thinner, or if considered less trouble, the tops of the new segments can be filed off, providing the clamping ring has been screwed down far enough to tighten all the old segments.

In repairing a large commutator, the same course is to be followed; but as in such a case it would be expensive to make a clamp to hold the segments in place when the clamping ring is removed, it will be necessary to resort to a different expedient. An effective method in such a case is, to wind a layer of wire around the commutator, first placing on each side of the point where the new segments are to be put in, pieces of wood, so as to raise up the wire band far enough above the surface at that point to permit of the removal of the segments.

It frequently happens that the shanks of the segments to which the wires are attached are separated from each other by an open space, and in such cases it is not uncommon for the voltage of the machine to drop below the normal, by the accumulation of dust between these shanks, specially if copper brushes are used. To prevent this trouble it is advisable to cover the shanks with a strong canvas, as shown at *K*, in Fig. 5. When the brushes spark badly and the defect cannot be remedied, owing to defective proportioning of the machine, it is a good precaution to cover the clamping ring with a strong cord, closely wound and fastened together with varnish. This arrangement is shown at *L*, Fig. 5.

When a new commutator is to be connected with an armature, and the wires are to be soldered in, it is safe to cover the backs of the shanks with asbestos, as shown at *J*, Fig. 5. This should be soaked full of shellac varnish so as to make it waterproof. If this covering is used, and grooves are cut through it for the wires

to pass into the slots in the ends of the shanks, there will be very little danger of the solder flowing over from one segment to the other, and thus causing a short circuit.

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Letters from Practical Men.

The Mathematician vs. the Constructor as a Student.

Editor American Machinist:

What is an engineer? Is he mathematician, constructor, or both? Is he a product of our engineering schools, or born to the profession? What kind of a man is demanded from our courses of engineering? Do these courses meet the demand? If not, why not?

Such are the questions which follow from Professor Hutton's recent article on "The Mathematician vs. The Constructor as a Student." For my part, I am sorry to note (but not in Professor Hutton's remarks) a certain tendency which we all have to disparage the mathematics of an engineering course. I say "tendency," for I believe that our natural experience after graduating from such a course usually fails to include in its many variations the practical use of mathematics to the extent we had been led to expect. Hence the natural query as to the profit in the study. It seems to me that there can be little argument on the question when we really think seriously about it, for the very idea of a trained and educated engineer without a well grounded mathematical foundation is inconceivable. I admit that there are engineers, good ones, without it, and their excellence in judgment, and remarkable success in the sense of proportion cannot be denied. But of them the discussion is not. If we have engineering schools their purpose must surely be to educate men to the profession of engineering from well-grounded principles, not from natural inborn genius. This is what we expect from such schools, and if, instead, we graduate mathematicians, and not constructors, or constructing engineers, then I am inclined to believe that it is not because of too much mathematics but because of too little constructive teaching. Few of our courses to-day have too much of the mathematical element in them for the proper equipment of a trained engineer to enable him to read and study intelligently and be prepared for emergencies. As for the weeding out of men in engineering schools on a mathematical basis alone it is evidently unfair, and is, I believ, a result of misdirected effort somewhere. Any man who has the determination to become an engineer will in some way get hold of the mathematical end if the subject is rightly put before him. One or two articles which have been published since the question was raised have avowed the necessity of practical illustration to make the study come home to the student. We should certainly expect this and it is doubtless carried out in most of our schools. It lacks, however, the essence of true constructive engineering. The men we demand from the schools are constructing engineers, not full-fledged, of course, but men with the business idea, men who are prepared to discriminate against unbusinesslike methods, men who can handle their theory and not allow their theory to handle them.

This demand our courses do not meet. The lack of constructive ability is so marked in most graduates during the early term of their experience, that there is a serious loss of respect not only for them, but for the institution of which they are supposed to be the finished product. We are constantly hearing such a remark as, "Well, you cannot expect much from a college man for a few years, anyhow," and we calmly accept it as a fact without the possibility of a cure. Now, I hold this to be wrong. We should expect a great deal from a man who has invested several thousand dollars in an engineering education. There is no reason why he should not be sought after to raise the standard of the profession he enters, instead of passing as a low-grade man to be gradually bolstered up to a position of usefulness.

I have no thought that any school course can replace actual business experience; but as there are physical laws which control the design and operation of machines, so there are practical laws of construction which control their successful production. The latter are as truly laws of engineering as the former, and I contend can be as easily imparted to the student. This business idea is not attained in the design and construction of a machine or machines by the graduating class, as at present performed. Suppose the class to organize themselves into a manufacturing company, how much would they know of putting their machine in shape for the market! What does the man who builds a 25 horse-power electric motor for thesis work know of the production of 500 similar machines to stand the test of mechanical excellence, interchangeability and ability to compete in weight, price and simplicity with a motor of another make? Why should not these matters be brought up and discussed as part of the engineering course?

Problems involving such points of constructive engineering are the first ones which present themselves to the young engineer. He is looked upon unfavorably because his business sense has not been cultivated sufficiently to enable him to make the headway he should on such problems. His training has a weak point in it, and as long as there is not an actual constructor in charge of a department to strengthen this weak point, so long will we continue to graduate mathematicians, men with perhaps their fill of theory, but not men with a conception of the demands of constructive engineering.

A Chair of Constructive Engineering! Why not? A department exclusively devoted to a study of engineering from an intensely practical standpoint. A man in charge of this department who has already attained success, not as a theorist, but as a constructor. A man who, by constant study of the latest methods and discussion of the same, keeps himself a constructor still, instead of merging himself into a mere teacher. A man to infuse the business idea into his students, to appeal to their sense of lively competition in the improvement of systems, and change of methods. And, with it all, a man to skillfully weave into his instruction such application of the pure mathematics as will relieve its dullness and command for it the involuntary respect of the student.

I believe much could be accomplished by a department as outlined above. I want to see the engineering schools furnishing men to the profession who are in possession of data scientifically gathered and arranged, data of practical business value. I want to see the engineering world respect these men for what they bring into it. It seems to me that the Chair of Constructive Engineering, rightly instituted, would do much toward this. If some study in the course must be sacrificed to make room for it, then I say, let mathematics alone and cut out all the others, if necessary. Most of the courses would, in my opinion, stand considerable pruning, to the advantage of the new department I suggest.

Good engineering is mechanical economy scientifically applied. A good engineer is a trained economist, with a fund of knowledge of theory and construction well under his control.

CHAS. L. GRIFFIN.

Holyoke, Mass.

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Wood Pulley Litigation.

Editor American Machinist:

In your issue of the 13th is an article, apparently editorial, entitled "Wood-Pulley Litigation," which does violence to the facts which it purports to state, and to that extent is unjust to us and misleading to your readers.

The Dodge & Philion patent for improvement in split pulleys was granted July 4, 1882. The implication of your article is that this patent covered nothing at that time new in the art, because you say—"Probably no one living has the slightest idea as to when the first iron split pulley was made," etc. You also say—"Upon the face of it, the Dodge & Philion patent of 1882 would seem to have been a very precarious one from the beginning," etc. These statements would not have been made except in entire ignorance of the facts.

In the first place, the patent was issued by the Patent Office after an exhaustive search by the attorney, prior to the ap-

plication, and an exhaustive search by the examiner. No one acquainted with the pulley trade during the past twenty years fails to know that this patent has revolutionized the business in this country and abroad, because he will know that prior to 1884 there was not, and could not be, such a thing as a "stock" of pulleys anywhere in the world, while now there is a "stock" in every considerable city of the United States, and in many of them several stocks, and that the principal cities of Europe and many of the cities in other parts of the world are similarly supplied. He will also know that this business grew directly out of the Dodge & Philion patent, and was the direct outcome of the business of the Dodge Manufacturing Company. He will also know that whereas that company commenced to manufacture these pulleys under the patent in question as early as 1881, it was not until about 1888 that any other manufacturer began to make pulleys on the same lines and with the features described in the patent, and he will also know that since about 1888 the number of different compression and standardized bushed pulleys put upon the market has been large, and that to-day a pulley cannot be successfully marketed which does not conform to the terms of this patent.

This is simple history, which I presume you were not aware of when the article was written, but which you may easily verify by inquiry of any competent disinterested person.

It is easy to look at a man and not see his soul, and it is equally easy to look at a machine without seeing the invention. So it is easy to look at something so simple as a Dodge pulley without seeing the force within it potential to revolutionize a whole department of the business. In the latter part of 1889 and the beginning of 1890, suits were commenced against the three most prominent infringers. These suits quickly ran together so far as the defense was concerned. The defense was managed by three of the most prominent patent law firms in the West and was prolonged through seven years of time. The country was raked for anticipations; testimony was taken in ten States and referred to twenty-nine anticipating users, ten prior patents, and a number of printed publications. The record amounts to nearly four thousand printed pages and cost the litigants probably $200,000.

When the case of one of these defendants came up for hearing last June, this entire record and pretty nearly a carload of exhibits were before the Court, and the counsel for one of the other defendants was present and assisted in the argument. The Court held the case under advisement from June until October, and then said all this mass of testimony was pertinent to the case, but that the defendants had failed to produce anything which impaired, much less destroyed, the validity of the patent.

You will agree with me that under a government of law, a time must come when questions of controversy must be regarded as settled. That time has come as to the validity of the Dodge & Philion patent. Under the law the validity has been settled, and other courts have already issued eight injunctions against makers of infringing pulleys.

The Saginaw Manufacturing Company's Gilbert pulley has never been before Judge Sage, and he has never made any allusion to it; therefore the statement that Judge Sage has decided that "the Gilbert pulley does not infringe upon the Dodge patent" is entirely untrue. We have pending four suits against the Saginaw Manufacturing Company to test that question, and it will be tested just as soon as the Court will hear us.

Under all these conditions it still appears to be easy to tell what every machinist knows has been common property for generations past, but we have to respectfully suggest that the case has been tried and for the present is closed, and that it will not be reversed without reasons more urgent than vague statements as to what machine-shop experts all over the country know about the history of the art.

R. D. O. SMITH
Sec'y Dodge Manufacturing Co.

[As the above rejoinder, in connection with the previous publication referred to, seems to do full justice to both sides, the interests of our mass of readers will not allow us to give more space to the matter. The old practices with split pulleys of iron are well enough known, but it will be unprofitable for all concerned for us to argue as to their precise bearing upon the present case.—Ed.]

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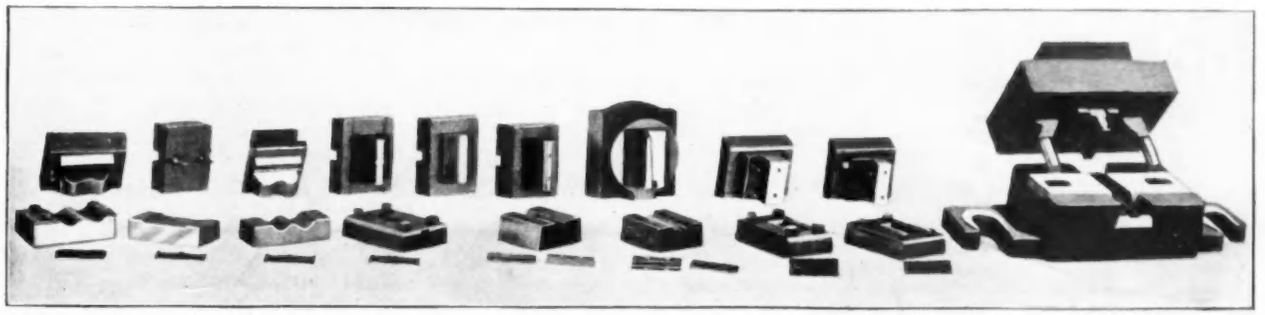
A Set of Dies.

Editor American Machinist:

We often hear it asked by those who are not mechanics, but who are financially interested in press work, "Why does it take so many dies to make such a small piece, and why do they cost so much for making?" and perhaps a few remarks on this side of the question of tool-making may be of interest to those parties.

I think that the punches and dies, and other tools required for making the ordinary kerosene lamp burner form as good an illustration as we could bring up, as the necessary tools for a burner of this kind, which sells from 3 to 5 cents each, will cost from $500 to $900, and this does not include the presses and other machinery used to operate them after they



A SET OF DIES.

are made. I send you a photo of a "set" of dies, and also the work which they are intended to produce, which is a pair of cartridge holders, intended for holding the same for rapid-firing of rifles. The photographer has made an attempt to show each successive operation on the holder by putting the partly finished blank in front of the die, but I think it is a failure as far as clearly showing what is wanted. The second and third dies on the right-hand end of the row are the blanking dies for punching out the holder and piercing the holes in the same, and the large die at the right is for bending holder No. 1, which is done in one operation, the sides of the blank being bent up in one operation by the center punch, and as it reaches the bottom of the die, the side benders are brought in by the incline shown on the two pins, and the top edges of the holder are bent over at right angles to the sides, thus finishing the holder in one operation. The bending of holder No. 2 is more complicated, and could not be done in one operation. It is bent up by the fourth die shown, and given a second bending by the fifth, and finished in the sixth die by the use of the two punches shown over the same. The last three dies are for making the springs used in the holder, one of which is cut off, bent and pierced

at one operation. The other is cut off, bent and then pierced on a second operation, the entire set being used to produce an article which would retail for 1 or 2 cents each, and requiring a set of dies which cost in the neighborhood of $500 to make.

I send you this, hoping it may relieve the feelings of some of your readers who have had experience in paying for work of this kind, and think they have been victimized at the price charged by the tool maker.

J. L. LUCAS,
With the Mossberg & Granville Mfg. Co.

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The Elliptic Quick-Return Movement.

Editor American Machinist:

Noticing the paper by Mr. Richards in yours of April 22d, I wish to call attention to the fact that the principal subject matter, the comparison of the speed of the motion at different points with that of a common crank motion, was published in a series of papers in your journal some seven of more years since, and afterwards in my "Treatise on Gearing." See section 149 and accompanying illustration, Figs. 134 and 135.

Mr. Richards files a claim on a method for making an elliptic gear, or a pattern for one, by first making a common circular gear and then forcing it out of shape to fit over an elliptic center. I have used that method for rough jobs for the past twenty years, and it was old when I first heard of it. It will do fairly well for a pattern, and only fairly well, when the eccentricity is small, but for a working gear or a nice job of any sort it is not worth a rap. The center is not an ellipse at all, but a lobed curve that is just near enough to an ellipse to be ugly.

GEORGE B. GRANT.

Boston.

[I have been a reader of the "American Machinist" from almost the beginning and have absorbed and assimilated much of the matter presented in it so completely that it is no wonder if some of it is reproduced without consciousness of obligation to my predecessors. It will do no one any harm, and some it may do good to tell over again even what has been well told before. Referring to the use of the elliptical gears for driving a cutting tool, as in a shaper or slotter, and comparing Mr. Grant's diagram, October 16, 1890, with my own, we may learn what it is to overdo the business. Mr. Grant assumes a ratio of 4 to 1, merely as an illustration of course, and while he secures a quicker return he does not secure as uniform a movement for the cutting stroke as my diagram gives with considerably less eccentricity. The speed near the ends of the cutting stroke in Mr. Grant's diagram is about 50 per cent. greater than at midstroke, so that, if the maximum speed of the tool determines the running speed, it would be necessary to reduce the driving speed and lose in that way what was apparently gained by the excessive quick return.

It will be news to many that Mr. Grant has ever done rough jobs; some of us never do anything else. My proposition of crushing a circular gear to elliptical shape was meant to apply only to gears that were slightly elliptical, and even then I did not propose to make them fit an elliptical center but to make them truly elliptical at the pitch line and then find some other means of mounting them. It is quite possible that a rougher man than Mr. Grant would have better success than he with so rough a job. It certainly does seen to me that it would be a boon to the mechanic if there were some better means of producing satisfactory elliptical gears. If he will not require an excessive eccentricity, as he apparently generally should not, it may yet be possible to gratify and satisfy him.—Frank Richards.]

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Mixing Shellac for Patterns.

Editor American Machinst:

We note in your columns an inquiry as to the best method of mixing shellac for patterns. The following results of our experience in this matter may be of use. We find that, everything considered, the proper plan is to purchase only the highest grade of thin orange shellac; carefully test this for dirt by holding up some of the scales in a strong light, and if much dirt is detected the shellac should be rejected. For mixing use only the best grade of alcohol. Common methyl alcohol or wood spirit should be avoided. It causes the shellac to coagulate in large "blobs," which cannot be redissolved and have to be thrown away. In the end this costs as much as good alcohol, which has no such evil effects. Further, shellac mixed with wood spirit has an aggravating habit of getting sticky when the pattern is rammed up in the sand, and gives a rough, dirty surface to the mold. It is therefore clear that such alcohol is doubly dear in the end.

By putting into the dissolved shellac some pulverized oxalic acid, using for one quart of the mixture a volume of acid about equal to that of a good sized pea, all dirt is precipitated, thereby clarifying the shellac and greatly improving its color. But owing to the poisonous nature of the oxalic acid, such shellac must not be used for doctoring up cut fingers, etc., after the custom current in most shops.

While the shellac is dissolving it should be thoroughly stirred every 15 minutes to prevent caking on bottom of the vessel. These cakes are extremely difficult to dissolve, and are usually thrown out. The handiest vessel for holding shellac when ready for use is a glass jar or mug. Carry across the center of this a tightly stretched wire, over which the brush is to be drawn to gage the quantity of shellac. Then provide this jar with a closely fitting cover into which cut an opening the size and configuration of which are such that when the brush is raised high enough to clear the surface of the shellac its handle will act as a plug to fill the hole in cover, thereby preventing evaporation of alcohol.

EDGAR KIDWELL.
GEORGE WASS.
Michigan College of Mines.
Houghton, Mich.

▲ ▲ ▲

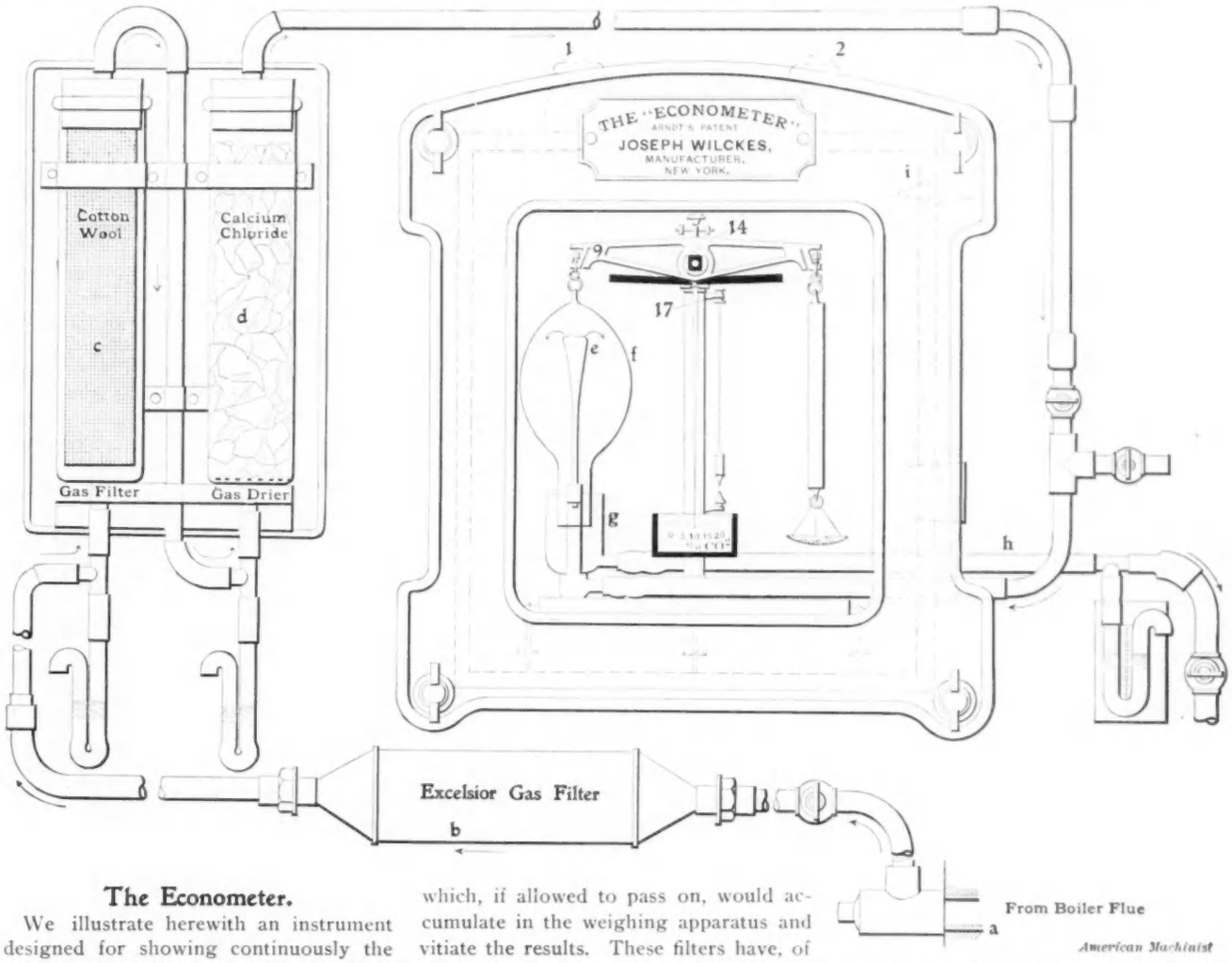
A Libel on the Engineer.

There is at least one style of piecework that is terribly demoralizing, and that is "space" writing for the periodical press. It probably finds its worst manifestations in what we may term the pseudo-technical journals. Here is a gem about the engineer of an ocean steamship. We charitably suppress the name of the publication in which it appears:

"It is sometimes interesting to see how little a great man may know; and by way of self-appreciative greatness I think I should place the chief engineer of a crack passenber steamer at the head of the list. The captain is a big man, retired and unapproachable, but for real bluff, burly, disagreeable greatness, the engineer is apt to be well in the van until he realizes that you do know the difference between a gage-cock and a crank-pin; then he is apt to mellow and be agreeable. This by preface. I sauntered into the engine room of a big steamer the other evening, where the engine was a magnificent example of triple expansion of the latest design. Of course I was interested, but as there were some parts that were out of sight, and as my eyes resembled Sam Weller's in not being 'a pair o' patent double million magnifyin' gas microscopes of hextra power,' and there being no Roentgen rays available, I could not see through cylinder shells and the like, so I asked a question or two. But I found that I could see all that the great man knew. He did not know the kind of packing used on his pistons or piston rods, nor the material of the same, nor the shape of his valves, nor the point of the cut-off in the various cylinders, nor whether his bearings were lined with babbitt, lead or brass, nor the stroke of his air pump, nor the cooling surface of the condenser, nor—well, nor anything I asked him. He had never taken an indicator card because he did not believe in them; he had never watched repairs being made because they were always done at the dock and it was not necessary for him to be about; in short, he had apparently never done anything but start her and stop her, and I went out wondering how such a man contrived to get such a place without having one grain of curiosity in his make-up."

"Sauntering" into the engine room is a good one to begin with. Anyone familiar with steamer discipline, and especially steamer engine-room discipline, knows how much "sauntering in" is done. And then the singling out of the one man

of the whole ship who is most responsible for the lives of the passengers and the safety of the ship and cargo as utterly ignorant of the intricate machinery under his command, is a disgusting exhibition. There is no chief engineer to be found who has not previously filled the successive subordinate positions, so that the requisite knowledge of detail could not possibly have escaped him. Business sagacity and business common sense do not select incompetent and ignorant engineers. It is possible that the writer quoted above, instead of "sauntering" into the engine room, sneaked in and was properly snubbed for his pains.



American Machinist

The Econometer.

We illustrate herewith an instrument designed for showing continuously the operation of boiler and other furnaces, and to enable the supply of air to be regulated intelligently so as to secure a minimum of waste heat in the furnace gases. The economical burning of fuel requires upon the one hand that sufficient air should be furnished to give complete combustion, but on the other hand, that no more than this be furnished, since all such surplus air must be heated to the furnace temperature. Of course, some surplus beyond the theoretical chemical requirements of the fuel is necessary to secure complete combustion, but any surplus beyond that represents a loss, and the purpose of this apparatus is to indicate whether such hurtful surplus is being supplied.

The apparatus consists essentially of a delicate balance which continually weighs the flue gases, and thus indicates their composition. Carbonic acid gas, as is well known, is heavier than air, and the weight of the flue gases thus depends upon the amount of carbonic acid gas they contain, and the weight is an index of the composition. The air is drawn from the furnace flue through the connection at *a* and passes first through the gas filters *b* and *c*, the first being the coarse filter and the second the fine. The purpose of these filters is to remove the dust, which, if allowed to pass on, would accumulate in the weighing apparatus and vitiate the results. These filters have, of course, to be renewed occasionally, and they are so arranged that this can be easily done. The first filter is placed as near as may be to the boiler, in order to prevent the dust passing on and obstructing the pipes. After passing the second filter, the gases pass through the drier *d*, which is filled with calcium chloride to absorb the moisture. Passing from the drier through the connecting pipes, the gas is finally discharged through the rose head *e* into the gas holder *f*, which is a balloon-shaped vessel of glass, its open mouth hanging within the glass cup *g*. From *g* the gas is drawn through the connecting pipe *h*, which connects with the chimney through an aspirator if necessary. The draft of the chimney through the pipe *h* thus causes a constant circulation of gas through the instrument, and the gas holder is constantly filled with gas representing the product of the furnace. The gas holder, as will be seen, is hung from one end of a delicate balance, whose pointer, moving over a graduated scale, indicates directly the percentage of carbonic acid. The scale is mounted in a cast-iron box with a glass front, which is air-tight except for the air inlet *i*. It is essential, of course, that the box be filled with atmospheric air, and the regulating cocks are so adjusted that the draft through the tube *h* constantly draws the air from the case, and so insures that it shall be filled with air only.

A suitable supply of air gives from 10 to 15 per cent. of carbonic acid in the flue gas, and any deficiency in that percentage indicates that too much air is being admitted, and vice versa, although a surplus and not a deficiency of air is the rule.

This instrument is being introduced in this country by Mr. Joseph Wilckes, 106-108 Fulton street, this city. It is the invention of a German engineer named Arndt. It is said to be in use to a considerable extent in various European countries.

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We invite correspondence on subjects pertaining to machinery.

Name and address must always be given, though not necessarily published.

Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.

Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.

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Patents.

There is probably no legitimate field of business in which so much illegitimate work is done as in that of patents. We do not here refer to the industry of selling county and State rights, which we think is not so active as formerly, but to the business of patent soliciting as now carried on. Every few days we receive pamphlets put out by solicitors, some of which are no doubt legitimate in intent and are published by upright and honorable practitioners, in order to give information for which they are often asked; but there is no doubt that the leading object of many of these publications is to induce the inexperienced to unwisely spend money on patents. It is so easy to take money from an inventor for this work without doing anything which is technically dishonest or dishonorable, that the industry of "working" the inventor has come to be very actively prosecuted. It is hard to believe that some of these publications are written with anything less than a deliberate attempt to deceive, as when they lead one to believe that of the nearly half a million patents issued to date, a large majority have been more or less profitable. The leading purpose of these publications is generally to show that anybody can patent almost anything (which, in point of fact, is true), and then to follow that up with a glorification of the general subject of patents, with statements of some of the great fortunes which have been made through patented articles, leading to the inference that a patent is the open door to fortune. This inference is usually enlarged upon by statements of the amounts made from trifling inventions. Near the end comes usually the statement that "delays are dangerous," while at the conclusion is a statement of the fees required. Some of these gentry go so far as to advertise a fixed sum for their own fee and to add "No patent, no pay." Either of these statements attached to one of these documents should be enough to warn an inventor against it. It would be as reasonable to expect a physician to name before hand the fee for curing his patent as to expect a patent solicitor to name his charge for securing a patent. The value of a patent depends upon its claims. The conscientious solicitor always endeavors to make these as broad as possible, and where this is done it very seldom happens that references are not cited against the application by the Patent Office, which sometimes require the claims to be canceled, but more often require changes, which in some cases are largely verbal so far as their importance goes. These amendments are in turn often rejected, and a long course of correspondence and skilful work are involved in finally securing the allowance of claims to which the inventor is justly entitled. The fixed fee and no patent no fee people, either draw such narrow and valueless claims at the start as to avoid any references, or in case they do not succeed in entirely avoiding references, either cancel the claims outright, or draw new ones still narrower and still more certain to go through. This should not be understood as reflecting upon the practice of naming, as a guide, an ordinary fee for an ordinary or simple case. It is not, however, possible for any solicitor who intends to do his duty by his client, to name positively beforehand the amount of his fee, as he has no means of knowing beforehand the amount of work involved.

Regarding the oft-repeated statement that delays are dangerous, there is probably no field of work in which delays are less dangerous than in taking out patents. Few things justify being patented before they are tried. The United States patent laws are the most liberal and favorable to the inventor of any in the world, and by them he is allowed two years of public use of his invention prior to the date of his application without in any way prejudicing his right. In an ordinary case the inventor should show a drawing or a photograph of his invention, or the machine itself to a few of his personal friends. The drawing should be signed and dated by these friends, or a signed and dated statement that the machine was seen by them should be made. In case of any question of priority ("interference") between him and another inventor, this drawing or statement will serve as proof to the patent examiner of the date to which he is entitled. The immediate filing of an application can do no more than this, as any patent is liable to be thrown into interference during the first two years of its life. The only reason for haste that can possibly be urged is the avoidance of interference, and this is accomplished just as well by the method described as by filing an application. Meanwhile the inventor's ardor will have a chance to cool down, with the probability, in most cases, that the expense of an application will be saved.

In general the obtaining of a patent is only a very small beginning toward getting money out of an invention. Only those who have tried it know the difficulty of enlisting the interest of manufacturers in putting these things upon the market. In general, inventors without means and without opportunities for enlisting the interest of others, should be very slow indeed about spending money on patents for inventions, no matter how promising they may be.

These statements only outline the beginning of an inventor's troubles. The allowance of a patent by the Patent Office is not law, and questions of infringement are always likely to arise if the invention is really valuable—questions which can only be settled by expensive litigation. It has been said that a patent is only "a license for a law suit," and when an inventor like Mr. Edison says, as he did not long since, that patents are a delusion, the average inventor may well think twice before spending his hard-earned dollars in that way.

The cheap patent solicitor flourishes largely because the inexperienced do not understand the difference between a good patent and a poor one, and imagine that because an invention is patented it is thereby protected—an impression which is erroneous. The solicitor who prepared the claims for Elias Howe's sewing machine, saw that the essense of the invention lay in the "fluted reciprocating eye-pointed needle," and worded his claim accordingly. Had he not been a superior man, he would have made his claim to cover the various links in the chain of mechanism by which the stitch was formed, and the first inventor who succeeded in making a stitch by a different chain would have evaded the patent. This example illustrates in a few words the difference between a good claim and a

poor one. There is no field in which one man seeks the expert advice and assistance of another—excepting that of medicine—in which it is more important to employ good talent than in the preparation of patents.

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Technical Books.

STEAM HEATING DATA. By Wm. J. Baldwin, M. Am. Soc. C. E.; Mem. Am. Soc. Mech. Engrs.; Expert in Ventilation. Published by the Author, 106 and 108 Beekman Street, New York. 28 pages, 4½ x 6½. Price 50 cents.

This little book, the entire text of which is equal to about three of our pages, does not consist of data, as the word is usually understood, but gives a very clear account of the author's simple method of estimating and computing the various details of steam heating and ventilating requirements, with, in conclusion, seven empirical rules entitled: Heat Units, Pounds Weight of Steam, Coal Required, Size of Grate, Size of Chimney, Required Horse Power, Boiler Surface.

THE MECHANICAL ARTS SIMPLIFIED. A Work of Reference for the Use of Architects, Architcetural Iron Workers, Builders, Blacksmiths, Bookkeepers, etc., etc., Ice-Making and Electricity. Compiled and arranged by D. B. Dixon. Appropriately illustrated. Chicago: Laird & Lee, Publishers. 1897. 497 pages; 8¼ x 5½ inches. Price $2.50.

This is simply a "new and revised" edition of a collection of tables and miscellaneous information, some useful, some worthless, none very new or up to date. The sources from which the matter has been collected are not given, and generally no indication as to the weight of authority appears. A few cheap cuts from trade circulars are inserted.

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Mr. Jas. McLaughlin, formerly with the Bass Pumping Engine Company, has been elected general manager of the Gray's Ferry Foundry & Boiler Company, of Philadelphia, Pa.

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The following interesting data are published of the conditions of running of the "Turbinia," which, as our readers know, is driven by the Parson's compound steam turbine:

Mean revolutions of engines.	2,100
Steam pressure in boiler.....	200 lbs.
Steam pressure at engines....	130 lbs.
Vacuum at exhaust of engine.	13½ lbs.
Speed of boat.....	31.01 knots
Calculated thrust horse-power.	946
Calculated indicated horse-power	1,576
Consumption of steam, reduced to basis of 31.01 knots.	25,000 lbs.
Consumption of steam per indicated horse-power per hour	15.86 lbs.
Total weight of machinery, including boiler, condensers, engines, auxiliaries, shafting, propellers, tanks, water in boiler, and hotwell, in working order.....	22 tons
Indicated horse-power per ton of total machinery.....	72.1

On April 10th the "Turbinia" attained the highest speed ever reached by any steam vessel, 32¾ knots (37.66 miles) on the measured mile.

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The Massachusetts Institute of Technology announces the following places and dates for entrance examinations: Boston, Mass., at the Rogers Building, 491 Boylston street, on Thursday and Friday, July 1st and 2d. A second series, for those unable to be present in July, will be held on September 21st and 22d. Also at the following places, July 1st and 2d: Belmont, Cal., at the Belmont School. Buffalo, N. Y., at the Buffalo High School, Court and Franklin streets. Chicago, Ill., at the Medill High School Building, Fourteenth place and Throop street. Cincinnati, O., at the Technical School of Cincinnati, Elm and Fourteenth streets. Cleveland, O., at the University School. Denver, Col., at 924 Washington avenue. Detroit, Mich., at the Central High School. Easthampton, Mass., at Williston Seminary. Exeter, N. H., at Phillips Academy. Kingston, Pa., at Wyoming Seminary. Lawrenceville, N. J., at the Lawrenceville School. Louisville, Ky., at 527 West Oak street. New York, N. Y., at the Fifth Avenue Hotel. Philadelphia, Pa., at the Lafayette Hotel. Pittsburgh, Pa., at No. 701 Ferguson Block, 123 Third avenue. Portland, Me., at the Portland High School. Pottstown, Pa., at the Hill School. St. Paul, Minn., at the Mechanic Arts High School. Utica, N. Y., at the Utica Academy, Academy and Bleecker streets. Washington, D. C., at the Franklin School Building, Thirteenth and K streets, N. W. Requirements for admission: To be admitted as a regular student in the first-year class the applicant must have attained the age of seventeen years, and must pass satisfactory examinations in Algebra, Plane Geometry, Advanced Algebra or Solid Geometry, French or German, English, and History.

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The Ingersoll-Sargeant Drill Company, which has so long had its headquarters in this city, is now an English limited liability company, with a capital of $2,000,000. The London directors are M. P. Grace, J. E. Dudly, R. W. Chapin, for many years president of the company, and G. A. Philips. The American directors are W. R. Grace, John A. McCall and W. L. Saunders. The factory will, of course, continue in full operation at Easton, Pa. The profits of the company for 1896 were $250,000.

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Lewis E. Gurley, the surviving brother of the original firm of W. & L. E. Gurley, the well-known makers of surveyor's instruments, died at his home in Troy, N. Y., on May 18th. Mr. Gurley's father had an iron foundry in West Troy in 1816. The deceased was born in Troy in 1826. He graduated from Union College in 1851, and the instrument business came into the hands of the Gurley Brothers under the present firm name in 1852. Mr. Gurley was a plain man, always in the shop and working with his men, with his apron on like the rest. He was a leader, especially in educational enterprises, in his native city.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(76) E. J., Brooklyn, N. Y., asks: Which is the best and most economical system of feeding water into a 10 horse-power boiler? The water has to be lifted 25 feet, it being that distance below the surface. Would you advise inspirator, steam pump or power pump? A.—Circumstances would determine which means of feeding would be best and most economical. With the meager information given, we would advise using the power pump, placing it as low as possible.

(77) G. H. J., Coaticook, Canada, asks if a belt should be so placed that the splices on the inside will point toward the direction of motion or against it. A.—It depends upon the pulley on which the belt slips. If it slips on the driving pulley the splice should point in the direction of the motion, but if it slips on the driven pulley it should point opposite to the motion. A belt so placed will obviate any tendency of the slipping to curl up the edge of the splice. At the same time, we think it very seldom that any attention is paid to the matter.

(78) Otis, Louisville, Ky., asks for a composition for small brass packing rings that will have a good spring. A.—Try copper, 5 pounds; tin, 1 pound; zinc, 1 ounce. If this does not give the desired results, reduce the copper to 4½, 4 or even 3½ to 1 or tin, or a little antimony may be substituted for the zinc if the results do not suit you. These mixtures will be hard to finish, but they are being used right along in the construction of injectors. It is difficult to give definite instructions in these matters, as different people's ideas of hardness and stiffness differ so much. We know of one case where the same castings were sent to two parties for the same purpose, and while one party returned them as too soft, the other rejected them as too hard.

(79) J. K., New York City, asks: What is the rule for determining the horse-power of a gas engine, both indicated and actual? A.—The "indicated" horse-power of a gas engine is obtained from the indicator diagram, just as the horse-power of a steam engine is computed, except that in the case of the steam engine the diagram is usually the same for each successive stroke, while in the gas engine the expansive force of the exploded gas acts usually every other stroke and at one end of the cylinder only. In some gas engines the "cycle" of operations is different from that in others. The actual horse-power is usually ascertained by one of the familiar forms of dynamometer. The power cannot be ascertained by computation alone, so that there is no available "rule" that applies to the case.

(80) J. S., Chicago, has calculated the fibre strain in a cast-iron beam having a load which he knows it will carry, and obtained a value beyond the known tensile strength of the material, and desires to

know the reason. A.—The usual formula for the strength of beams is not reliable for calculations of breaking loads. That formula assumes, as a fundamental proposition, that the stretch of materials is proportional to the load applied, which proposition is true up to the elastic limit; beyond the elastic limit the assumption is no longer true, and the formula breaks down. The calculated fibre stress, which is apparent only, obtained from beams loaded to the breaking point, is called by some authors the modulus of rupture, and should always be used in place of the true tensile strength when calculations of the breaking load are to be made. For cast-iron having a tensile strength of 20,000 pounds per square inch, the modulus of rupture is about 35,000. It should be understood that this statement does not indicate that these formulas are not reliable when applied to working loads, since under such loads the material is strained within the elastic limit. In other words, calculations of the fibre stress of beams loaded within the elastic limit should give results approximating the truth, but with beams loaded beyond the elastic limit they do not give true results.

(81) "Compressor" writes: I have a 12 x 14-inch straight-line air compressor running two 3¼-inch rock drills. At times the steam drops as low as 50 pounds, and then the compressor fails to supply air enough. 1. Is the compressor large enough for the work? A.—If the compressor will keep up the air pressure when the steam pressure keeps up, then the compressor is large enough and the trouble is at the boiler. If the air supply falls when the steam pressure falls, it is only because the speed of the compressor also falls. 2. If the steam cylinder was increased to 13 or 14 inches diameter, would it remedy the matter? A.—It would not. It would not do the same work with any less steam. If the air cylinder were increased an inch in diameter, the air capacity would be proportionately increased, and the steam cylinder would still have power enough to drive it. The working air pressure for the drills should be kept up to 75 or 80 pounds, and the steam pressure should never be below that. 3. What rule is there for determining the number of rock drills of a given diameter, a 12-inch steam x 12-inch air x 14-inch stroke compressor, should run with a given steam pressure? A.—It can only be said in a general way that a 3-inch rock drill will require about 100 cubic feet of free air per minute, and a 3½-inch drill about 150 cubic feet. The actual free-air capacity of compressors is always less than the theoretical capacity given in the catalogs. As a matter of fact, a 12-inch compressor is not quite large enough to keep two 3½-inch drills running continuously. It is usually assumed that one or the other of the drills will be stopped a considerable portion of the time. The question of steam pressure scarcely applies to the case. There must be steam enough to keep the compressor running up to speed. Any higher pressure would not increase the volume of air delivered, and the speed of the compressor would drop off rapidly when the steam went down.

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Commercial Review.

NEW YORK, SATURDAY EVENING, MAY 22.

THE MACHINE TOOL MARKET.

The letters from leading machine-tool manufacturers on the business situation, which were published in the last number but one of the "American Machinist," seemed, on the whole, to evince a hopeful tone. Consequently, in undertaking, this week, to inquire what was the feeling among our local machine-tool fraternity on Liberty street, it was with the hope that something better might be found to report than hitherto. However, no avalanche of trade has yet begun to slide down Liberty street, and that thoroughfare retains the same sober and conservative aspect, commercially speaking, that it has worn for an indefinite time in the past.

Now and then an order or two more than usual drifts into some office, swelling the total for the week and making the recipients thereof feel as if business had begun to mend; but, contrariwise, there are periods of especial inactivity, so that if things were levelled off, it would be pretty hard for an observer to determine how one month differed from another.

Two weeks ago the New York branch of one of the largest New England houses received business which brought the week's total up to about as high a footing as that of any they have experienced since the establishment of the present agency. But it was merely because some large business happened to get closed up at that time, and now they are dull again. Three or four doors away is an establishment which has been experiencing an improvement this week. Just across the street they speak in this calmly analytical fashion: "We are encouraged by the feeling of a little better business. We have had a few inquiries, and two or three of them have materialized into fair orders. Still, trade has been in such a state that we draw encouragement out of very small things."

Here are a few scattered remarks as to the kinds of business noticed by different parties: "We have received some orders from abroad for tools of the larger medium sizes, which seem to indicate that the Europeans are branching out upon a demand for machinery other than for bicycle work. The sales of our Chicago store have lately been much larger than those in this city.". . . . "The tools we are now selling are of a very general nature, with no one line, such as those designed for sewing machine or gun manufacture, seeming to predominate." . . . "People are not buying large tools, and the small ones they are only buying from hand to mouth."

Second-hand machinery is selling largely as compared with new. We understand that the recent sales of one prominent house are pronounced as consisting of second-hand machinery in the proportion of about nine-tenths. This kind of business hinders the sale of new tools, but it has the advantage of often bringing in good profits.

Two parties who have started out in the machine-tool business in this city during the present year report some improvement in trade. One of them notices it in the way of greater inquiry, which, however, he finds to be slow in coming to a head.

An important Eastern company report from their works that they are running on longer weekly time than formerly, owing, however, to special circumstances. Domestic trade they regard as generally dull, without prospect of change during the summer. Orders from abroad, however, are beginning to come in well by mail, and they are just sending a representative to the other side.

The New York branch of the Niles Tool Works says: "We can report progress. During the last few weeks we have met with success at home, and the same can be said of our new London office."

EXPORTS OF MACHINERY—A DIGEST.

We give below a condensed statement of some of the export sales and shipments of machinery which have been made during the last few days, as compiled from the daily export news of the New York "Journal of Commerce." It shows what a respectable foreign trade is quietly being carried on.

One of the local houses has made a shipment of shapers, lathes and upright drills, valued at $65,000, for the London market. The Liberty Machine Company has shipped to Nicaragua a steam printing plant, said to be one of the largest ever sent to Central America. An order has been placed for fifteen upright boilers and engines and a quantity of electrical supplies for Mexico. The Lidgerwood Manufacturing Company have just received an order for three latest improved hoisting engines, from their agent in London, to which market they have already sent twenty this year. Two hundred and fifty tons of engines, boilers, railroad-shop machinery, etc., were being shipped by an export house this week to Yokohama. A certain banking house paid out $38,000 last week, to a Pittsburg concern, for seven pieces of machinery shipped for export. One export house has received a $62,000 order for five carloads of machinery, principally mining, to go to Australia. Three side-tank locomotives for Shanghai, China, have been ordered from the Brooks Locomotive Works. The Baldwin Locomotive Works are making shipment of four passenger, four freight and four shifting locomotives to the Chinese Government within the month. Twenty thousand dollars' worth of soap-making machinery has been ordered for shipment to, or via, London; and laundry machinery of about the same value is expected to be purchased next week for the French market.

A FEW TIPS ON EXPORT.

The following are some suggestions of possible future business: M. Mori, vice-president of the Japan Railway Company, of Tokio, is expected to arrive in New York early next week, and will probably make some purchases. A new company,

the Compagnie Generale d'Electricite de la Ville de Buenos Ayres, 8 Rue Rocher, Paris, has been organized, with the intention of building a number of electric railways, and a representative of the same is expected here in the latter part of June. The French and German contractors have a jealous eye on Buenos Ayres, in regard to electrical roads. Thirty-five wind-mills have just been ordered from that city, and there is said to be a demand there for soap, candle and brick making machinery. Trade with the Argentine, nevertheless, is said to be quiet. Machinery for harbor improvements, etc., is said to be apropos in San Domingo.

United States Consul Reed, at Tien-tsin,

(*Continued on page 36.*)

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Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Send $1 to the Tabor Mfg. Co., Elizabeth, N. J., for improved stop-motion revolution counter.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Cost of Manufacturing—Experienced manager will establish system of costs, giving exact account of every detail. Charge based on saving effected. Correspondence solicited. Geo. C. Thomas, 99 Nassau Street, New York, Room 212.

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Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday Morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Exp. mech. draughts. seeks pos. Box 24, Am. Mach.

Mech. draftsman and designer, tech. grad., exper. machinist, wants pos. Box 4, Amer. Machinist.

Position wanted by foreman boiler maker, hustler; references. Box 20, American Machinist.

Mech. eng. wants pos. June 1; exp. in electricity; also in design of automatic and general machinery. Box 217, American Machinist.

Machinist and draughtsman wishes position as instructor, machine designer, toolmaker or erector. Experienced teacher. Box 18, Amer. Machinist.

Wanted—Position as supt. or foreman; well up in modern boiler construction, tools, estimating and handling of men. Address Box 16 Am. Machinist.

Position wanted as superintendent or assistant; up in modern methods; good manager of men and a pusher; engines, general heavy and experimental work. Box 22, American Machinist.

Exp. machinist and draftsman, who has served as general foreman in different shops throughout the country, desires position as foreman or supt. Best of references. Box 216, American Machinist.

Tool maker, age 30, accustomed to bicycle, type writer tools; also experimental work; can act as assistant supt., which position have held before; best of references. Box 21, American Machinist.

Skilled machinist and tool maker, experience on tools, aut. mchy, engines and electrical des., recent tech. grad., desires pos. in draught room or charge of construction; good ref. Box 27, Am. Machinist.

A party with a number of years' exp. in mfg. companies desires a situation as assistant to some mfg. co. Details and management of help pref. Ref. furn. Ad. M. W. C., P. O. Box 1829, Boston, Mass.

Wanted—Position as superintendent or general foreman of a first-class tool or die room; 15 years' experience on die work; 5 years in last position; can accept July 1. Address "Foreman," care American Machinist.

Export—Educated mech. and drafts., 39, speaks English, French, German, Spanish, would travel Europe for cycle and other machinery, tools, japans and sundries; 20 years in business, 10 in Europe. Box 17, American Machinist.

Foundry Foreman—A first-class man, with special exp. in one of best shops in this country, is ready for an engagement; understands brass as well as iron founding; selecting and mixing irons a specialty for any purpose. Ad. "Moulder," Am. Mach.

Young man, technically educated, 6 years' shop, draughting and road exp., designing and erecting engines, pumping machinery, etc., desires a position at draughting or as assistant superintendent or foreman. Address "Newton," care Am. Mach.

Help Wanted.

Reliable mechanics to sell my calipers, etc.; good pay. Address E. G. Smith, Columbia, Pa.

Machinist wanted with $1,500 to join me with same amount in safe paying business. Address P. O. Box 36, Sparta, Wis.

Wanted—First-class man for crank lathe, also planer; permanent and desirable places for really good men. Box 25, American Machinist.

Wanted—A first-class die-sinker; one who is capable of laying out work and taking charge of die sinking in a drop forge shop. Address P. O. Box 266, Worcester, Mass.

Wanted—An experienced foreman to take charge of machine department of elevator works. State wages wanted and send references. Address Box 15, American Machinist.

Wanted—A young man to act as machinery salesman; must have some experience in New York. Answer, giving terms, references and experience, Box 23, American Machinist.

Wanted—An experienced salesman, who has a wide acquaintance with the hardware trade, to represent a manufacturing company and sell on commission. Address Box 13, Amer. Machinist.

Wanted—Foreman for foundry of New England concern manufacturing engines and machinery; young or middle-aged man, steady and reliable, experienced in modern practice; iron and brass; give age, experience, references and salary expected. Box 26, American Machinist.

Wanted—A man who can handle men and economically operate boilers, engines, refrigerating mach'y and elec apparatus, to act as chief eng'r for a packing house Address in own handwriting, giving experience, age and salary expected, H. C. G., Room 46, 240 La Salle Street, Chicago.

Machinists wanted in manfg. line. Works in operation 17 years without a case of shut-down, reduction of wages, or laying off of help. Wages $2 per day to ordinary machinists or machine men: $2 25 per day for good men on floor work. Factory in a small country town, one hour's ride from New York City. Preference given to men of family who will remove here for permanent residence. None but competent men need apply. State age, experience and give references. Box 19, care American Machinist.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S.M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Will sell at low figure patent No. 569717 Lubricator Pump. Fr. Kaufhold, Merseburg a/S. Germany.

Models, experimental and small special machy. built. Write to Crocker & Lawson, Binghamton, N.Y.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

Wanted—Every reader of this paper to send 35 cents for The Tool Catalogue. See Montgomery's advertisement on page 15 of this edition.

Wanted—Inventors before applying for a patent get "How to Apply for a Patent," $1. Sample pages free. Henry F. Noyes, 56 Liberty Street, N. Y.

Wanted—An Idea. Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co., Patent Attorneys, Washington, D. C., for their $1,800 prize offered to inventors.

A machine shop, with modern equipment, heavy and light machinery, cranes of 20 tons capacity and 10,000 square feet of unoccupied floor space, would contract to manufacture any kind of machinery. Parties already having machinery built under contract might do well to write us for estimates. Box 62, American Machinist.

GRINDSTONES FOR MACHINE SHOPS.
WILSON MITCHELL, 310 N. 4th St., Phil., Pa.
Send for "Grinding Instead of Planing."

Columbia University
in the City of New York.

SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
SCHOOL OF ENGINEERING,
SCHOOL OF ARCHITECTURE,
SCHOOL OF PURE SCIENCE.

Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded on application to the Secretary of the University.

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Difficult and Fine Metal Parts
Direct from the Molten Material; Holes, Threads, Slots, Gears, and all Shapes Cast to Exact Size.

FINISHED CASTINGS

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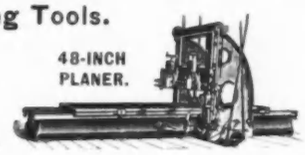
Originators and Sole Owners. Illustrated Circulars to Manufacturers who ask.

PLANERS

And other Metal-Working Tools.

FITCHBURG MACHINE WORKS,

Catalogue E Fitchburg, Mass.



48-INCH PLANER.

(Continued from page 35.)

China, advises the State Department that he recommends American manufacturers of car axles, wheels, springs and couplers, and of tools and machinery, to send catalogs and price-lists of the same to the Engineer-in-Chief of the Imperial Railway of Tongshang, near Tien-tsin, China; also, perhaps, of mining machinery to the Chinese Engineering and Mining Company, of the same locality, and of fire engines to the authorities of Tien-tsin.

LARGE SHIPMENT OF SOUTHERN PIG IRON.

The April reports of the Southern pig-iron business show shipments of 101,041 tons, of which 78,348 tons were from the Birmingham district alone. Shipments west amounted to 29,906 tons; east and north, 38,207; and for export, 32,838. At this rate the yearly shipments would amount to over 1,000,000 tons. The export phase is more active than it was last year, and is stimulated by advancing prices in England.

Quotations.

NEW YORK, Monday, May 24.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 00 @ $12 50
No. 2 foundry, Northern	11 00 @ 11 25
No. 2 plain, Northern	10 50 @ 11 00
Gray forge, Northern	9 75 @ 10 25
No. 1 foundry, Southern	10 25 @ 10 75
No. 2 foundry, Southern	9 75 @ 10 00
No. 3 foundry, Southern	9 50 @ 10 00
No. 1 soft, Southern	10 25 @ 10 50
No. 2 soft, Southern	9 75 @ 10 00
Foundry forge, or No. 4, Southern	9 25 @ 9 50

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.00 @ 1.05c.; refined, 1.10 @ 1.25c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.35 @ 1.45c.

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with some brands perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel — Ordinary brands, from store, in small lots, 1.50c.

Cold Rolled Steel Shafting—Base size, 2.50c., in small lots, from store.

Copper—Carload lots, Lake Superior ingot, 11⅛ @ 11¼c.; electrolytic, 10⅝ @ 10⅞c.; casting copper, 10⅜ @ 10⅝c.

Pig Lead—In carload lots, 3.25c., f. o. b., New York.

Pig Tin—For 5 and 10-ton lots, 13.60 @ 13.65c., f. o. b.

Spelter—In carload lots, New York delivery, 4.15 @ 4.25c., f. o. b.

Antimony—Cookson's, 7¼ @ 7½c.; Hallett's, 6.90 @ 7.00c.

Lard Oil—Prime city, present make, commercial quality, in wholesale lots, 37 @ 39c.

▲ ▲ ▲

New Catalogs.

There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

We have received from the L. S. Starrett Company, Athol, Mass., their catalog B of gear and milling machine cutters. It is 3¼ x 5¾ inches.

The J. W. Ruger Manufacturing Company, Buffalo, N. Y., has sent us a catalog of gas and gasoline engines. Half-tone engravings of the engine are given, and the catalog is 5 x 6¾ inches.

▲ ▲ ▲

Manufactures.

Miller & Sons expect to erect two elevators at Hunnewell, Okla.

At Waterville, Vt., Mr. Frank Laraway is building an addition to his mill.

(Continued on page 37.)

The Pratt & Whitney Co. HARTFORD, CONN., U.S.A.

...MAKERS OF...

Fine Machine Tools.

Complete Plants furnished for Bicycle, Typewriter, Gun and Sewing Machine Makers. Gauges and Small Tools for all Machine Work. Drop Hammers and Trimming Presses. Forging and Trimming Dies for all classes of work.

England—Buck & Hickman, 280 Whitechapel Road, London, E. *Chicago*—42 and 44 South Clinton Street.
France—Fenwick Freres & Co., 21 Rue Martel, Paris. *Boston*—281 Franklin Street.
New York—123 Liberty Street.

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4 POINTS!!!! Design! Workmanship! Material! Finish!

All these are comprised in the make-up of our lathes and are the four necessary points in the construction of a good tool. Add to these a FIFTH and a very important one, the price, which we make very low to prompt cash buyers, and you have the story. Our Catalogue will tell you all about our Lathes, Planers, Shapers, etc.

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Bolt Cutters, Drilling Machines, Punching Presses, etc. Send for Catalogue.

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Have done all my patent soliciting work, both for this and foreign countries, continuously for the past fourteen years.
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Foot Power Screw Cutting, Automatic Cross Feed, 9 and 12" Swing.
Send for Catalog B.
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WE CLAIM THE FOLLOWING MERITS FOR JENKINS BROS.' VALVES.

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2. No regrinding, therefore not constantly wearing out the Seat of the Valves.
3. Contain JENKINS DISC, which is suitable for all Pressures of Steam, Oil and Acids.
4. The Easiest Repaired, and all parts Interchangeable.
5. Every Valve Tested before leaving the factory.
6. ALL GENUINE stamped with Trade Mark.

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22 sizes in Helve, Upright and Strap Styles.
Send for Printed Matter.
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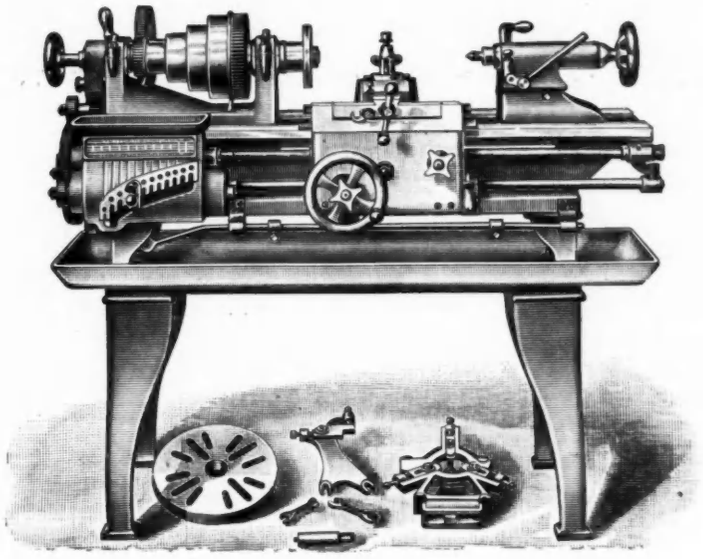
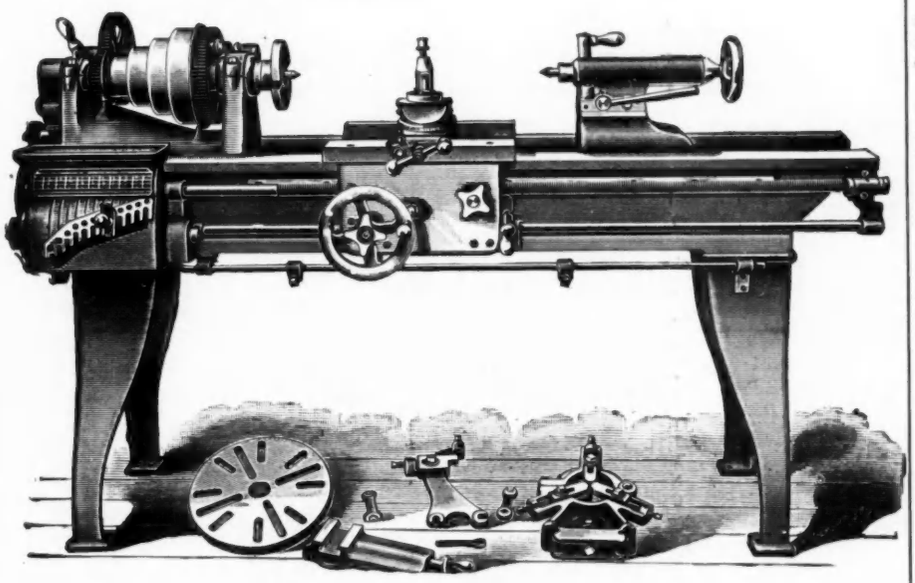


12" Hendey-Norton Lathe

is fitted with drawing-in sleeve and American Watch Tool Co's standard chuck, used in making small taps, reamers, etc. Work finished first and cut from bar afterwards. No centering required. See carriage reverse lever by right-hand side of apron; no reaching for countershaft shipper required.



14" x 6' Hendey-Norton Lathe.

These lathes are modern, high-grade, practical tools, and are specially adapted for tool-room work. They have the Norton Attachment for screw cutting, giving 36 different threads and 36 different feeds with only two changes of gear and movement of lever in gear-box from one notch to the other. Note the automatic stop under apron. It will automatically stop carriage at any desired point in either direction; invaluable for internal or duplicate work. SEND FOR CATALOGUE.

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Agents for the Pacific Coast, Pacific Tool & Supply Co., San Francisco, Cal.

European Agents: { Chas. Churchill & Co., London and Birmingham, Eng. / Schuchardt & Schutte, Berlin and Vienna. / Eugen Soller, Basel, Switzerland.

(Continued from page 36.)

The Sulphite Pulp Co., at Mt. Tom, Mass., are erecting a new boiler house.

The Falls Paper Company, at Neenah, Wis., will make additions to its plant.

At Chicago, Ill., a new pumping works is to be built on Central Park avenue.

The Norton Works, of Ashland, Ky., are to add a new rod mill to their plant.

Mr. Frank A. Carey, of Brewer, Me., expects soon to erect a new tannery.

Wm. Engel & Co., of Webster, Me., contemplate placing an addition to their mill.

L. Messenger & Co., of Johnstown, Pa., contemplate installing laundry machinery.

Neece Bros., of St. Petersburg, Tex., expect to place new planing-mill machinery.

At Clare, Mich., Gorr & Arrand's planing mill has been burned. The plant will be rebuilt.

The Adirondack Match Company, of Ogdensburg, N. Y., is preparing to make additions to its plant.

The planing mill of Henderling Bros. & O'Neil, at Valparaiso, Ind., has been destroyed by fire.

The Newton Milling & Elevator Company, of Newton, Kan., will increase its capacity and make additions to the mill.

Messrs. A. E. Hammond and J. F. Theriault have purchased some property at Van Buren, Me., which will be used as a sawmill.

At Marblehead, Mass., it is probable that A. J. Foster & Co., of Boston, Mass., will erect a plant there for the manufacture of morocco.

At Doylestown, Pa., the Wallace Co. contemplate the erection of a tallow manufacturing plant. The building will cost about $18,000.

At Ocosta, Wash., Messrs. D. L. Stone & Sons will operate a sawmill, which, until recently stood idle. New machinery will be installed.

The New York office of the Geo. V. Cresson Co., owing to increase of business, has been moved to more commodious quarters, at 141 Liberty street.

At Arctic, R. I., the Byfield Rubber Company has been formed. Messrs. P. H. Coyle, M. R. Downey and Terrence McCarty are the incorporators.

At Goff's Falls, N. H., the Manchester mills corporation contemplates the erection of a woolen mill. Machinery of the most improved type will be installed.

At Tyler, Tex., the Tyler Foundry & Machine Company has been incorporated. Incorporators, J. S. Christian, Claude R. Ward, and Clem H. Roberts.

At St. Paul, Minn., the R. Brownson & Co. Manufacturing Company has been incorporated, and will engage in the manufacture of various kinds of machinery.

Builders' Iron Foundry, Providence, R. I., have been awarded a contract by the United States Government for the manufacture of 12-inch B. L. R. steel mortars.

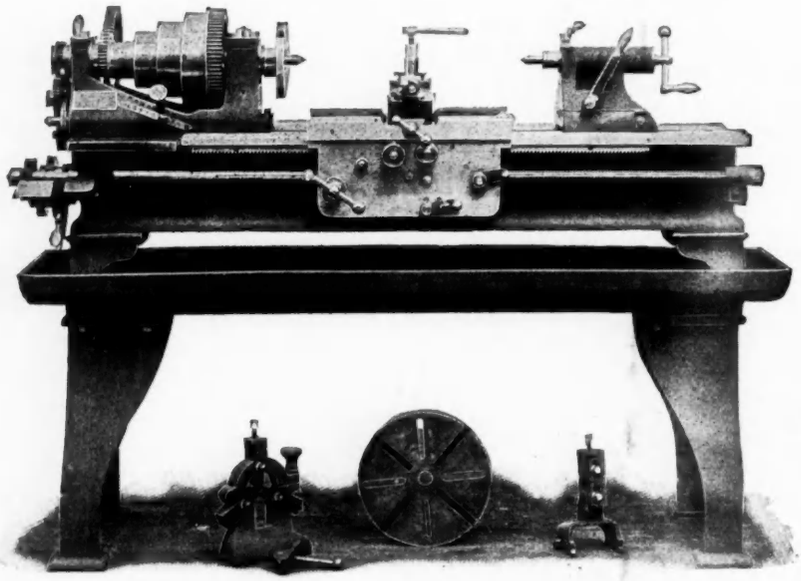
The Maryland (Baltimore, Md.) Cement Co. has been incorporated by J. L. Given, of Tompkins Grove, N. Y., Ed. H. Wales, of Hyde Park, N. Y., and Wm. G. Soldan, of Baltimore, Md.

The New York Metallic Paint Company, of Brooklyn, N. Y., has been incorporated. Messrs. Charles A. Klots, of Huntington; Walter J. Klots, and Fred. Lederer, of Brooklyn, are the incorporators.

We are advised by the Cleveland Tool & Supply Company, No. 5 Long street, Cleveland, O., that the agency recently held by them for the Davis & Egan Machine Tool Co., of Cincinnati, O., has been discontinued by mutual agreement.

We Desire to Sell All the 14-inch Lathes Wanted

▲ ▲ ▲



Have made prices so reasonable, and quality and capacity so good and great, that you cannot afford to overlook this Lathe, if you are in the market for a Lathe of this size.

We apply the planer principle on the Lathe, namely: VERY RAPID FEED FOR A FINISHING CUT.

It will do surfacing in ONE-EIGHTH THE TIME of the ordinary Lathe.

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THE GEARS ARE ALL MOUNTED AND NEVER NEED BE REMOVED.

It has independent friction and cross-feed, also friction length feed.

INDEX FOR SCREW-CUTTING IS EVEN MORE SIMPLE THAN ON THE OLD STYLE LATHE.

It has 1¼ inch hollow spindle.

It carries 2 inch belt.

It cuts threads as accurate as skill can produce.

It will earn more money than any Lathe offered.

It is simple; it is well made; it is accurate.

In short, it is indispensable.

In fact, you should write us about it.

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SPARKLESS Commutation.

HIGH Efficiency.

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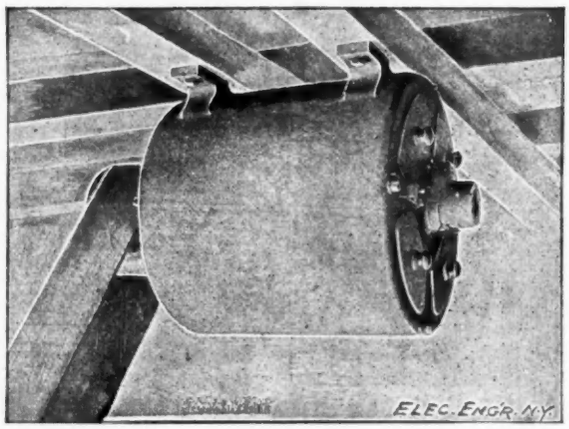

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FITTINGS, PIPE.
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Wyman & Gordon, Worcester, Mass.

FRICTION CONES.
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Will be found to be all that its name implies, and can be relied upon to act promptly in shutting off water from gauges when glass breaks, thus the danger and annoyance attendant upon closing of valves attached to gauges is dispensed with. Made of gun metal and every gauge tested and warranted, and satisfaction guaranteed.
Write for special circular and prices.

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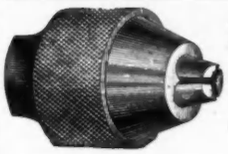

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BEVEL GEARS
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Whitney, Baxter D., Winchendon, Mass.

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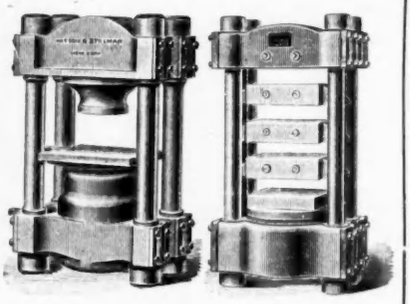

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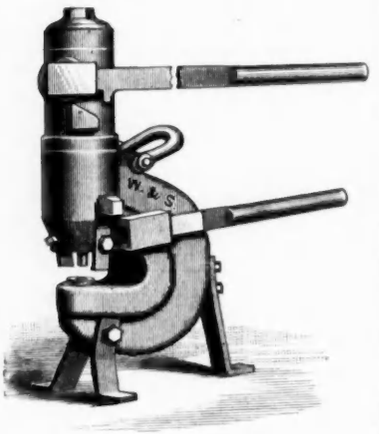

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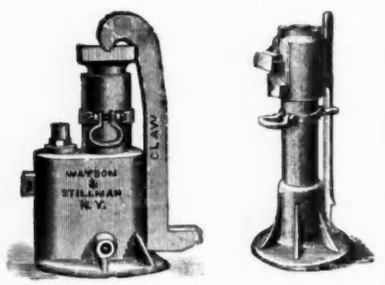

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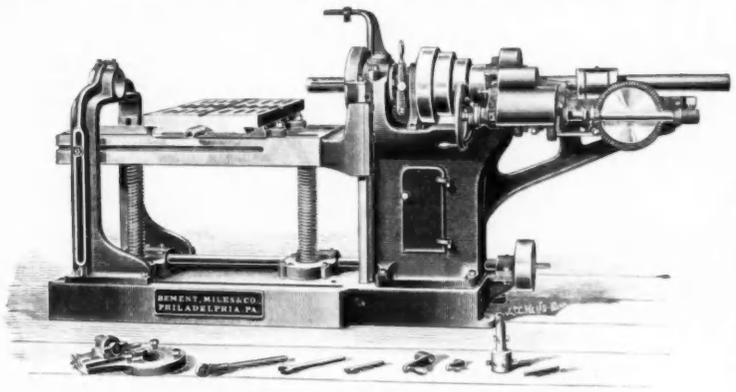

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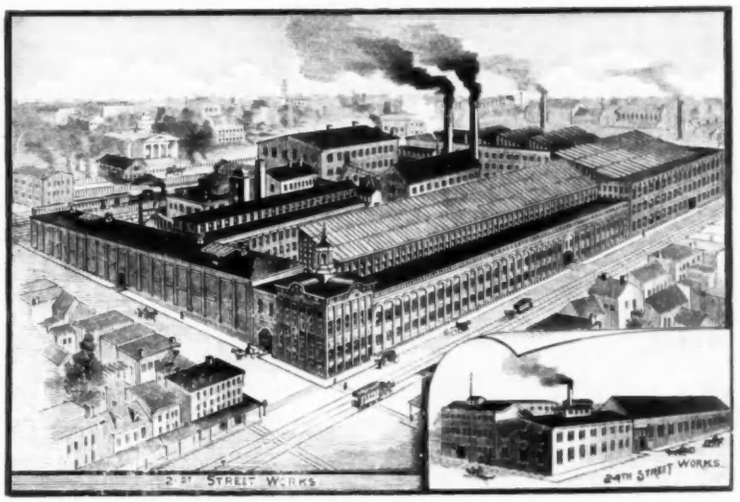

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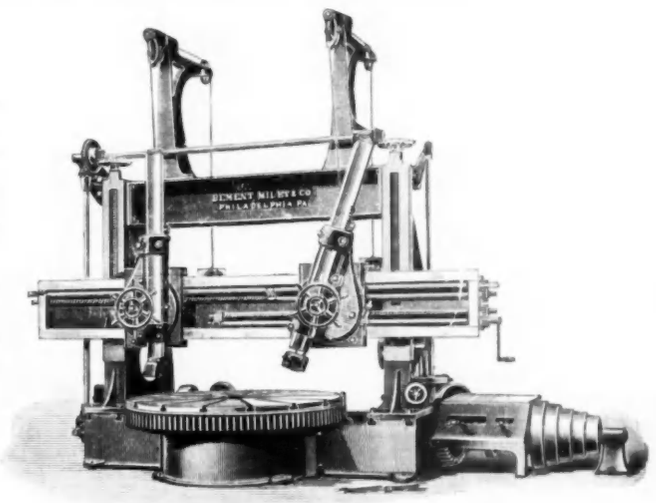

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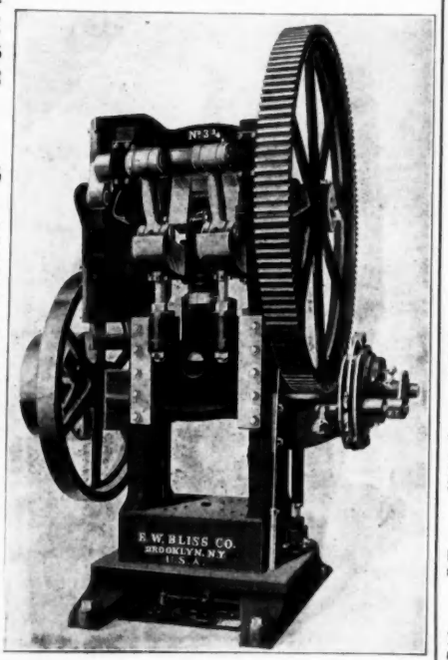

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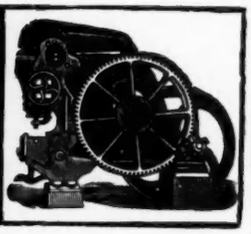

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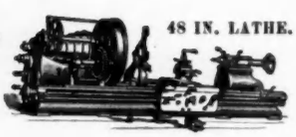

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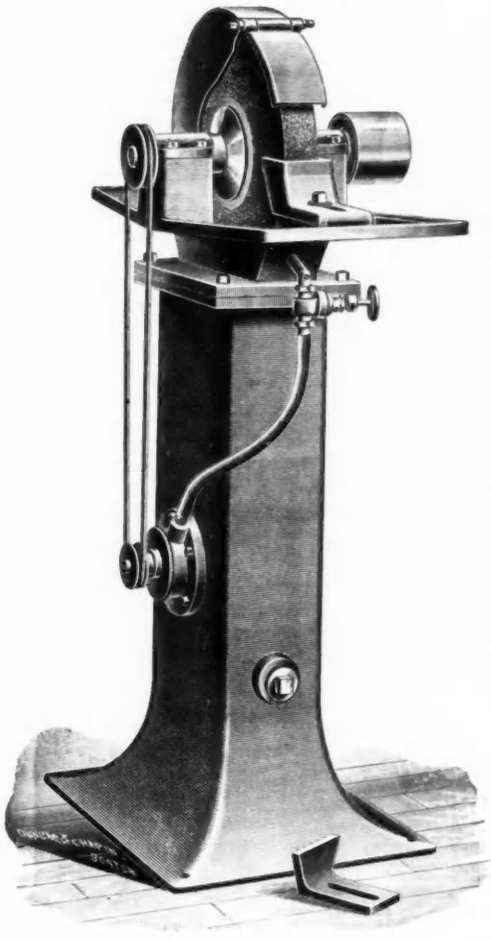

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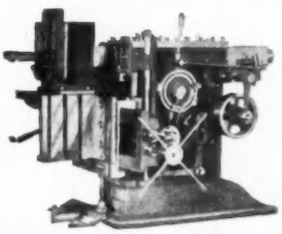

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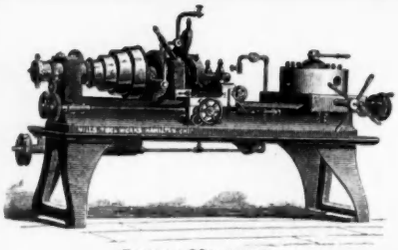

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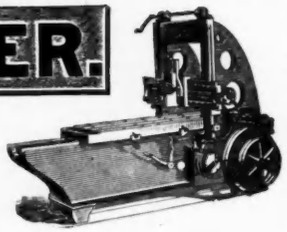

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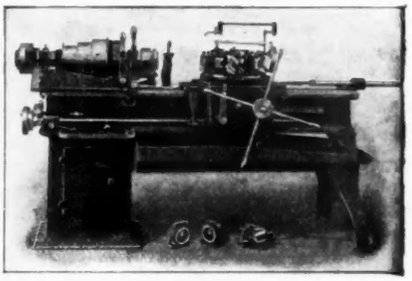

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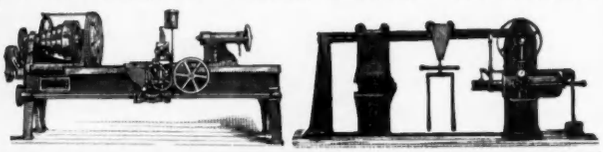

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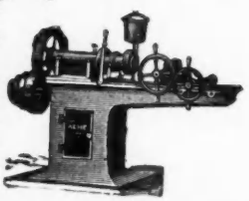

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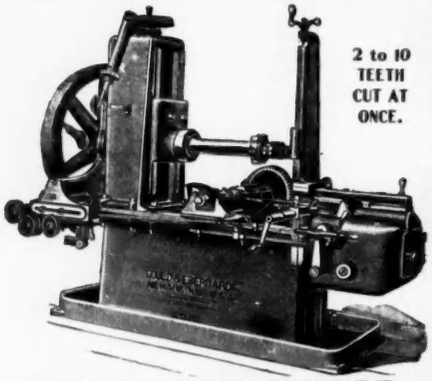

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